United States Patent [19]

Hashimoto

[11] **4,299,506**

[45] **Nov. 10, 1981**

[54] **MECHANICAL PENCIL**

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[73] Assignee: **Pentel Kabushiki Kaisha,** Tokyo, Japan

[21] Appl. No.: **70,741**

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[30] **Foreign Application Priority Data**

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Oct. 31, 1978	[JP]	Japan	53-134119
Nov. 28, 1978	[JP]	Japan	53-163668[U]
Feb. 14, 1979	[JP]	Japan	54-17949[U]

[51] **Int. Cl.**[3] **B43K 21/08**

[52] **U.S. Cl.** **401/72;** 401/195

[58] **Field of Search** 401/55, 57, 68, 72, 401/69, 71, 75, 79, 195, 57

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Primary Examiner—Edward M. Coven
Attorney, Agent, or Firm—Robert E. Burns; Emmanuel J. Lobato; Bruce L. Adams

[57] **ABSTRACT**

A mechanical pencil is disclosed which comprises a casing having a ferrule at its tip end and having an axially extending central bore formed therein, and a lead-containing sleeve fitted into the central bore and capable of containing a plurality of leads. The mechanical pencil includes a lead guide pipe which is mounted in the ferrule and extending into the central bore. A feed roller is rotatably mounted within the central bore between the lead guide pipe and the lead-containing sleeve for feeding a lead from the sleeve into the lead guide pipe. The feed roller has a frusto-conical configuration with its axis disposed at an angle with respect to the axis of the central bore, and is peripherally provided with a helical rib, which is adapted to engage the periphery of lead. A rotation is externally imparted to the shaft of the feed roller, thereby rotating it to feed a given length of the lead forward.

13 Claims, 22 Drawing Figures

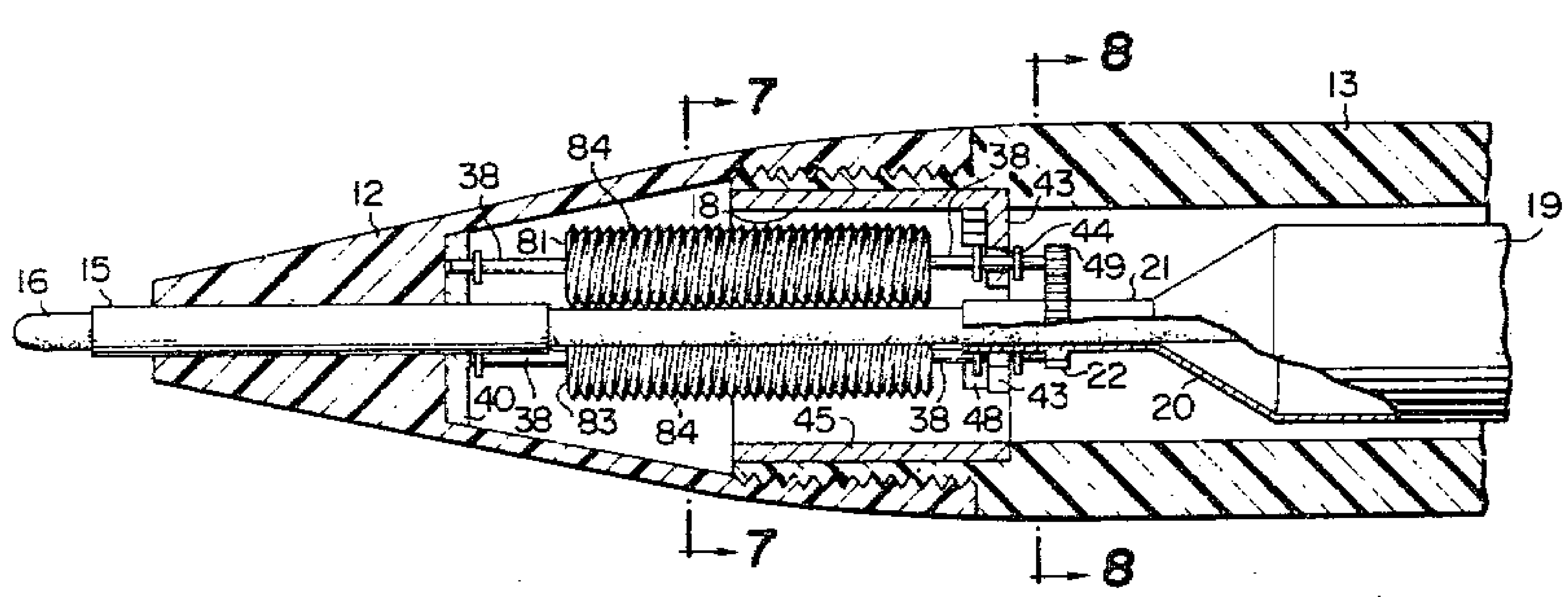

FIG. 1

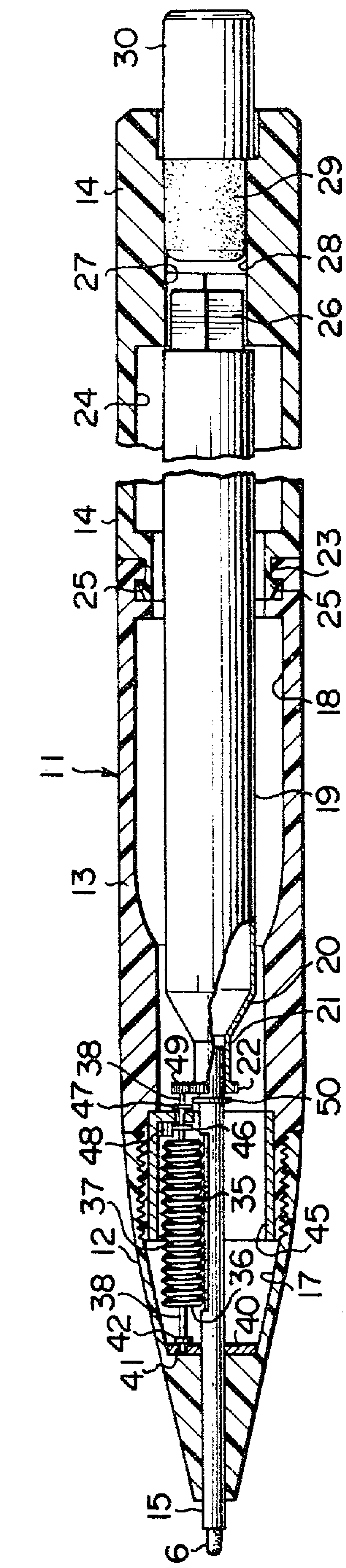

FIG. 3

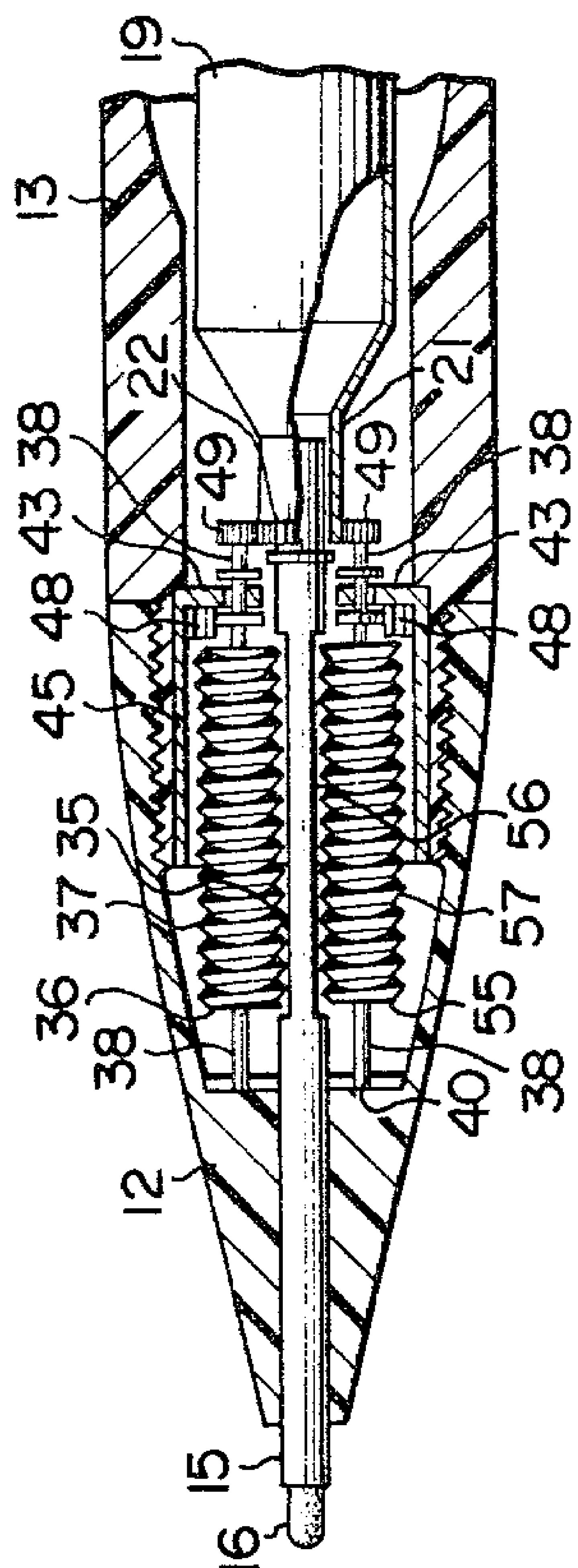

FIG. 2

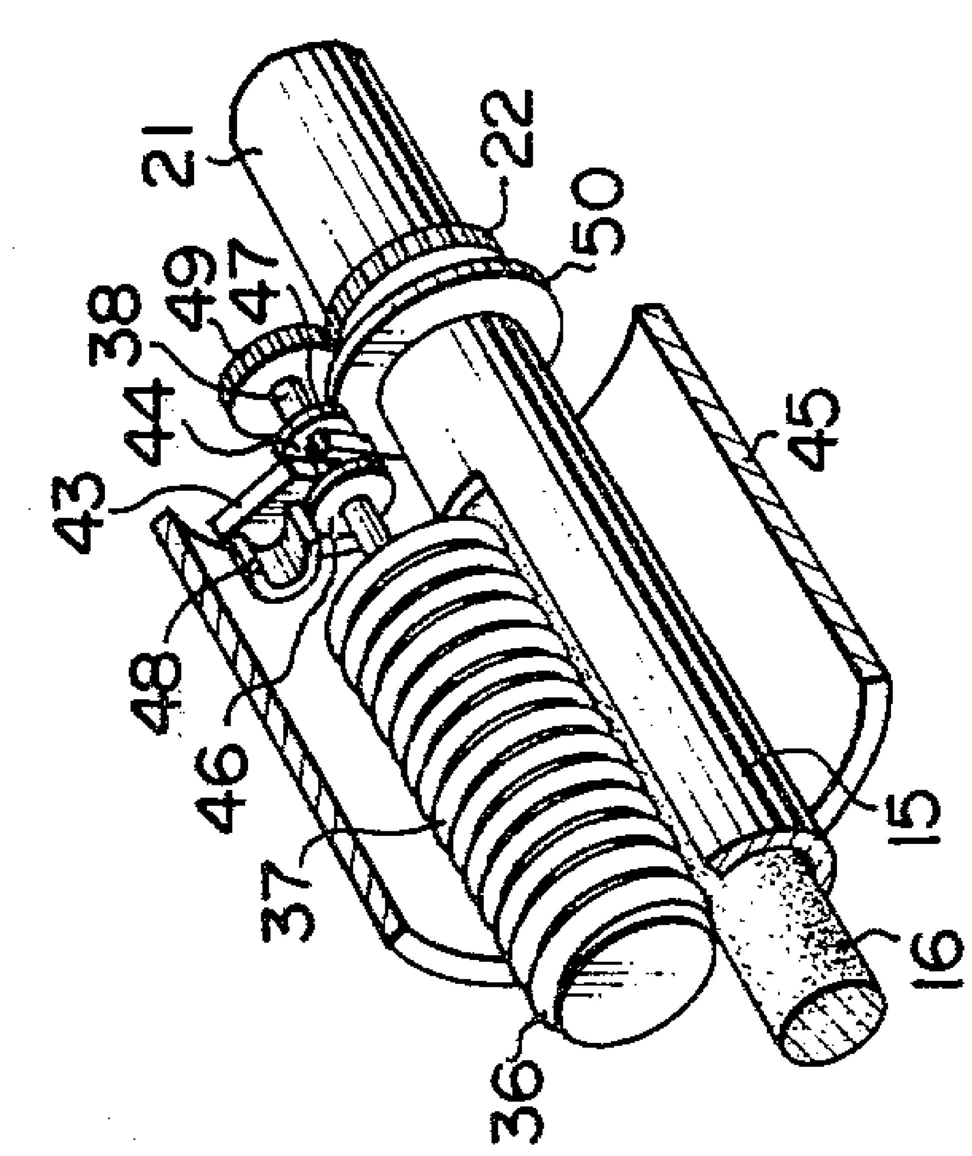

FIG. 4

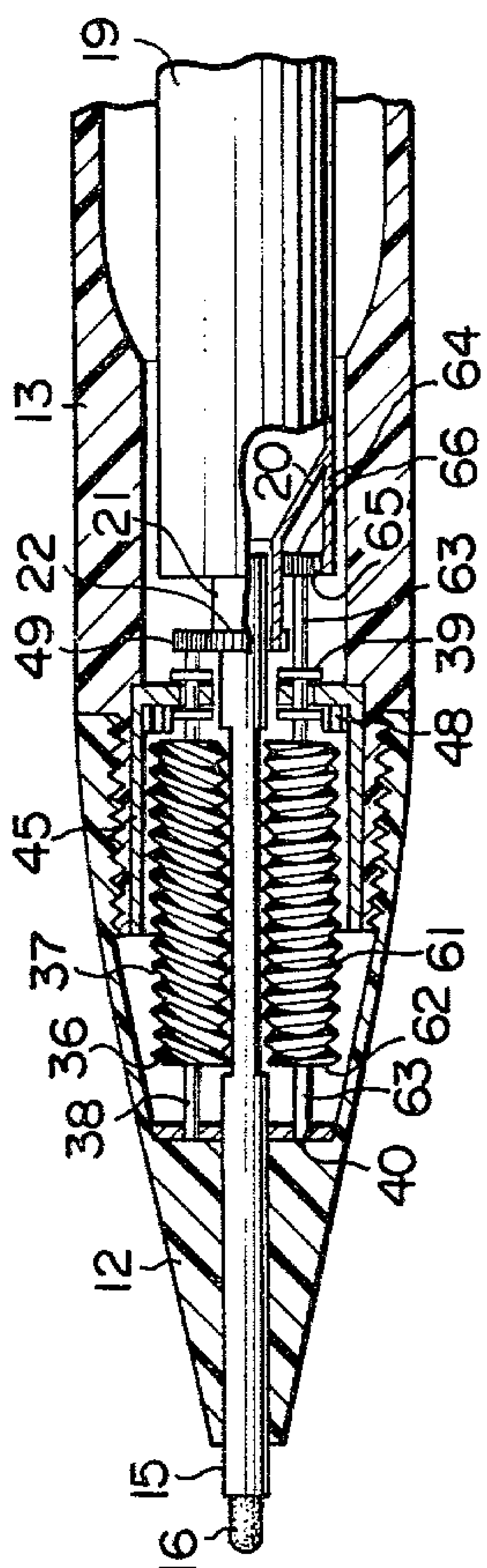
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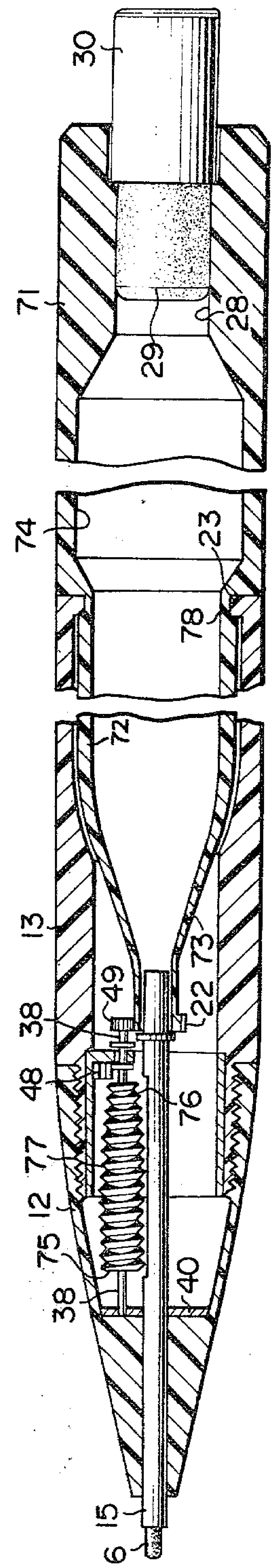
FIG. 5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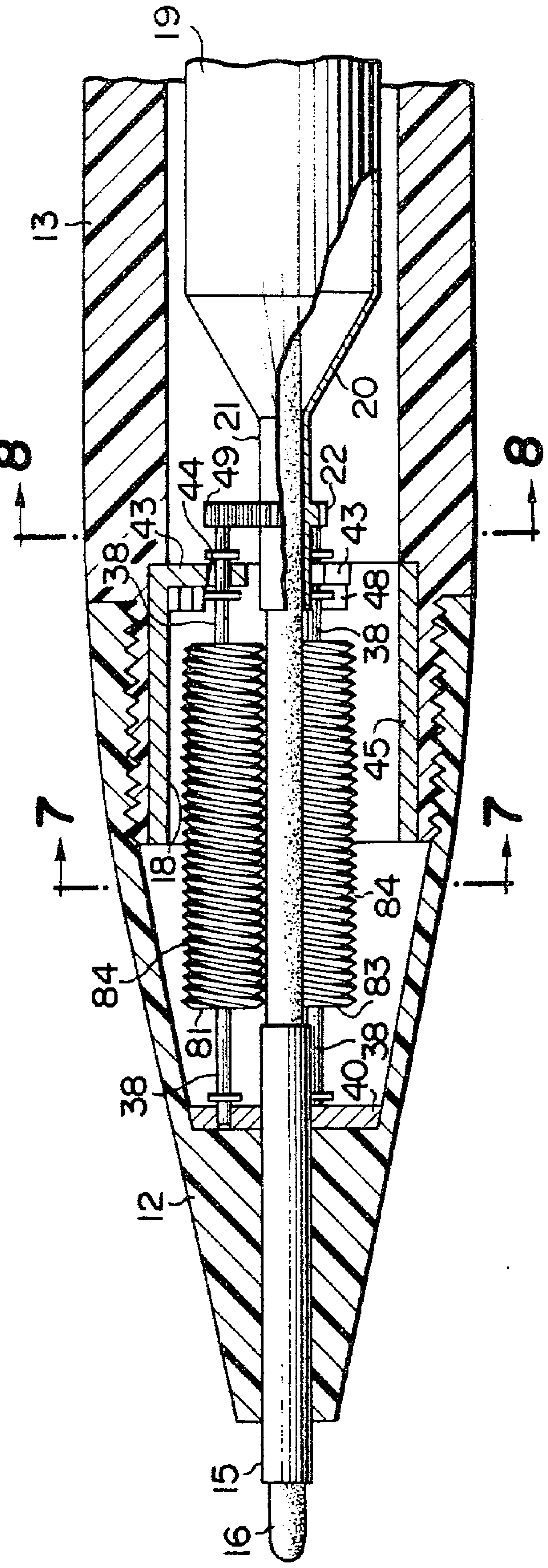

FIG. 6

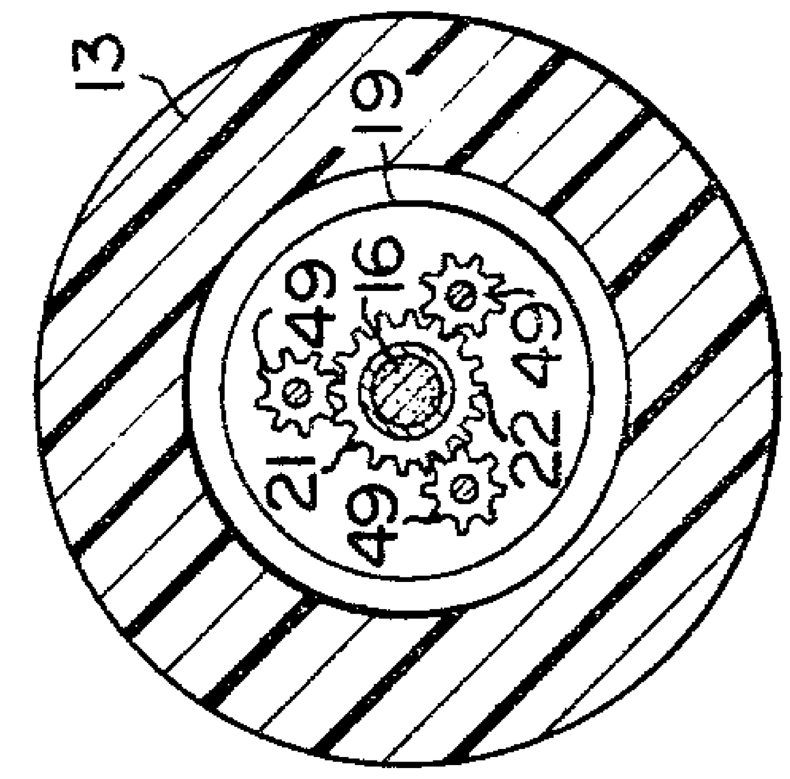

FIG. 8

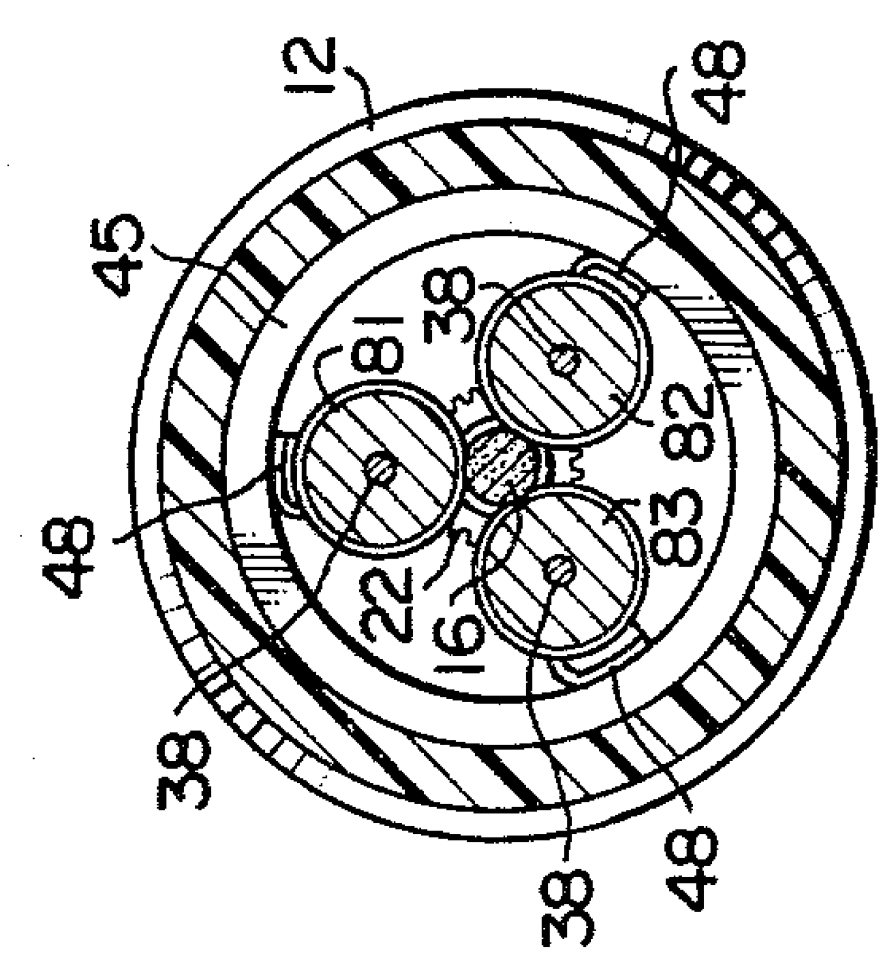

FIG. 7

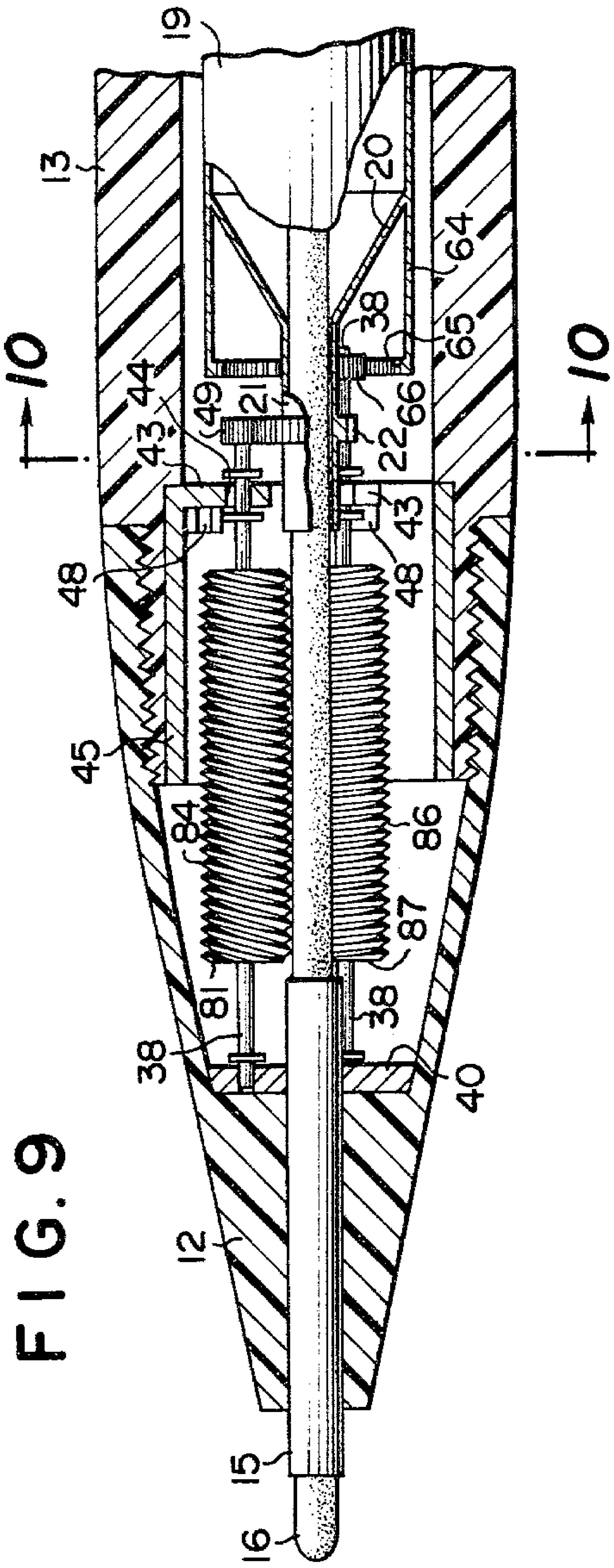
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FIG. 9

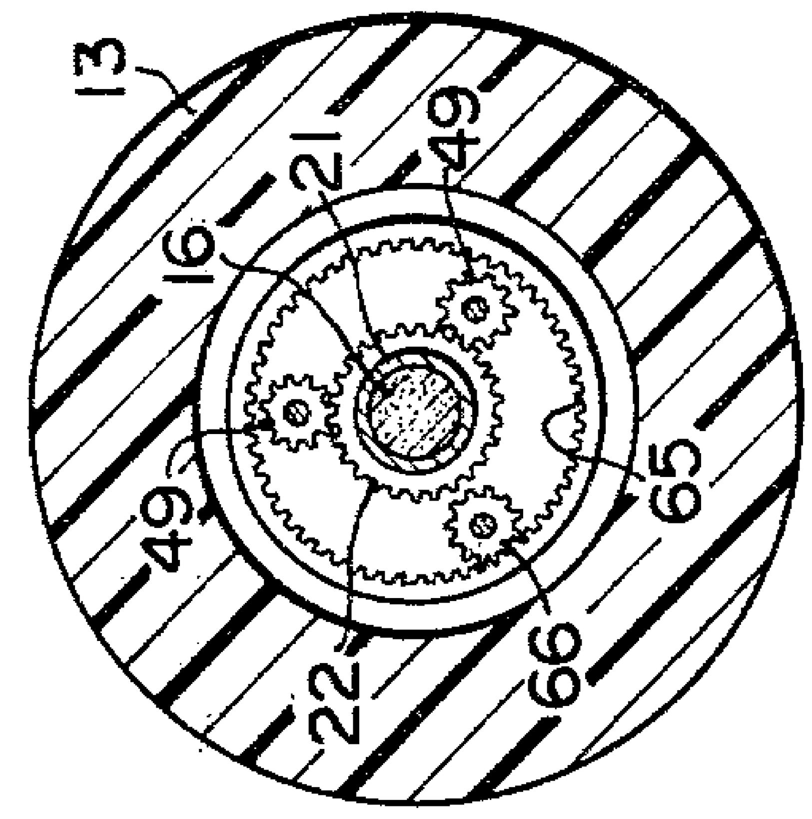
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FIG. 10

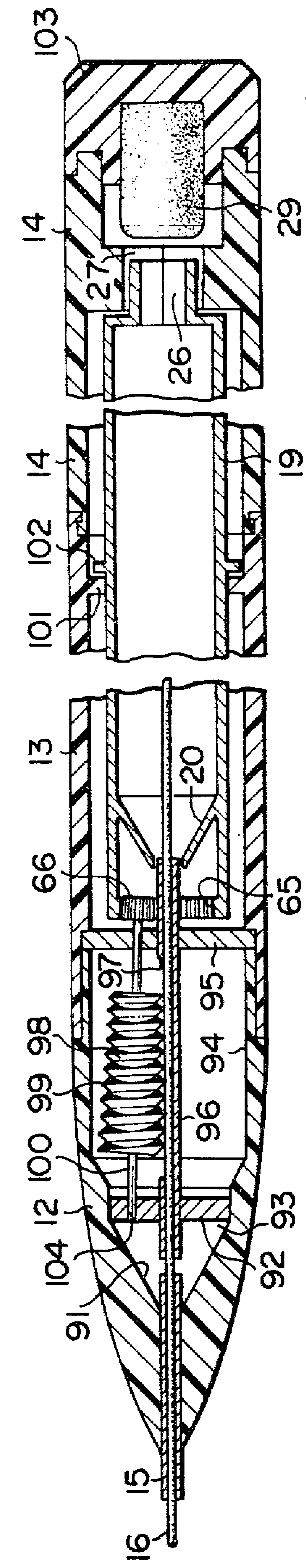
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FIG. 11

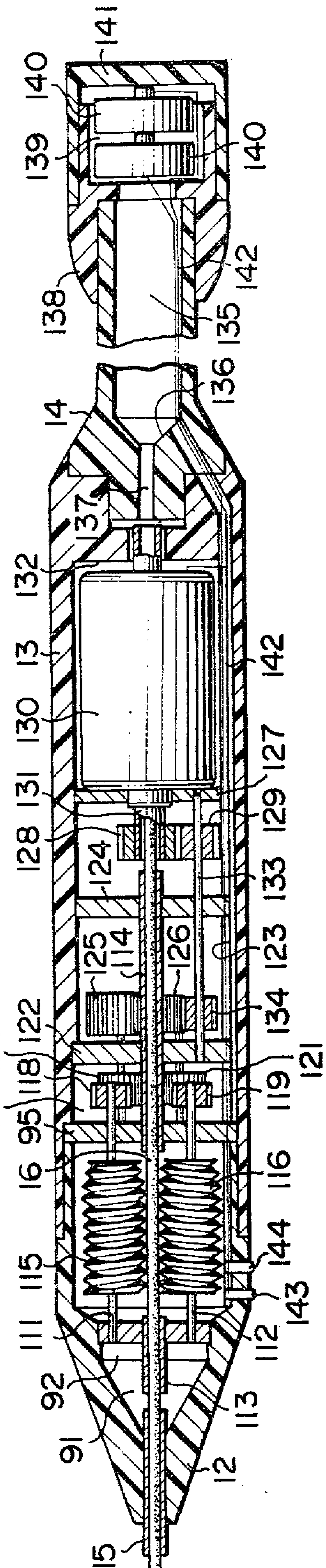
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FIG. 12

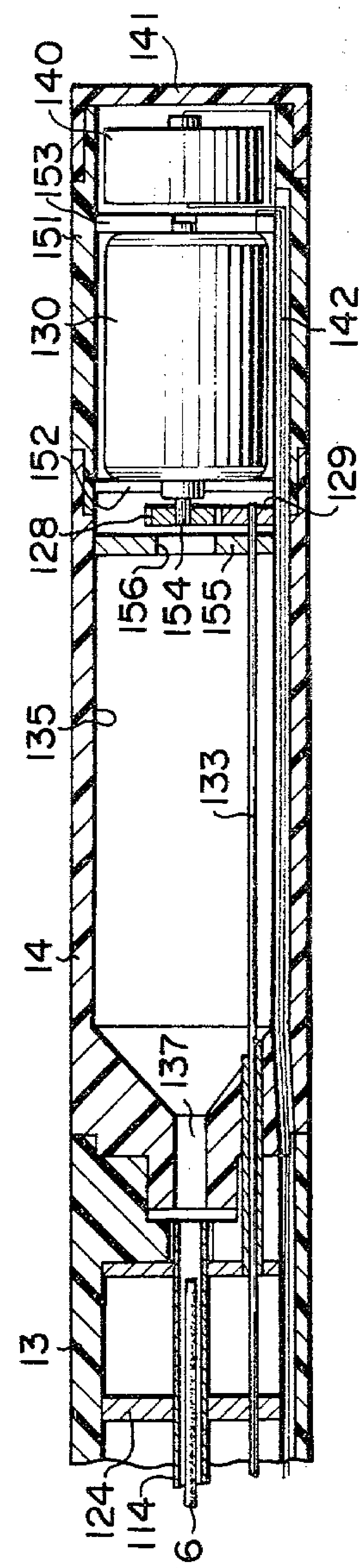
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FIG. 13

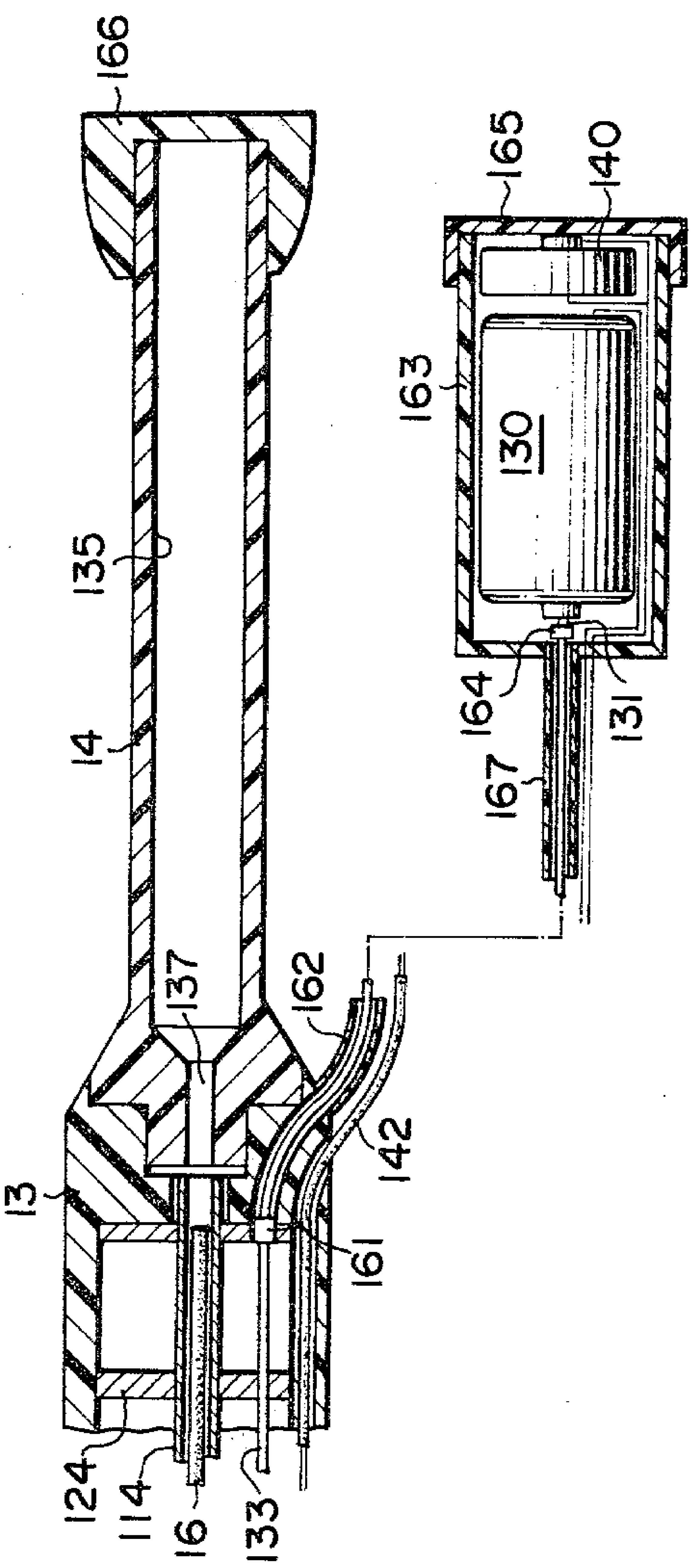
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FIG. 14

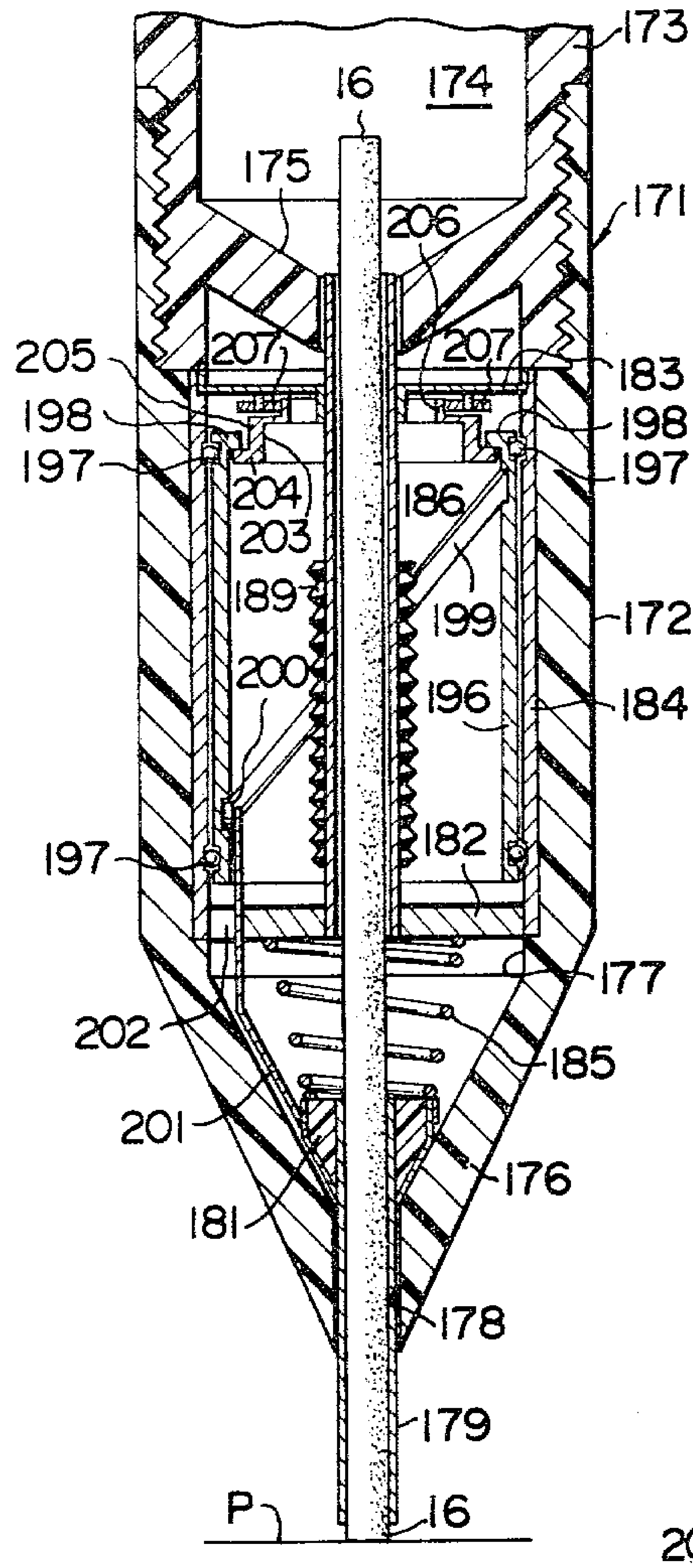
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FIG. 15

FIG. 16

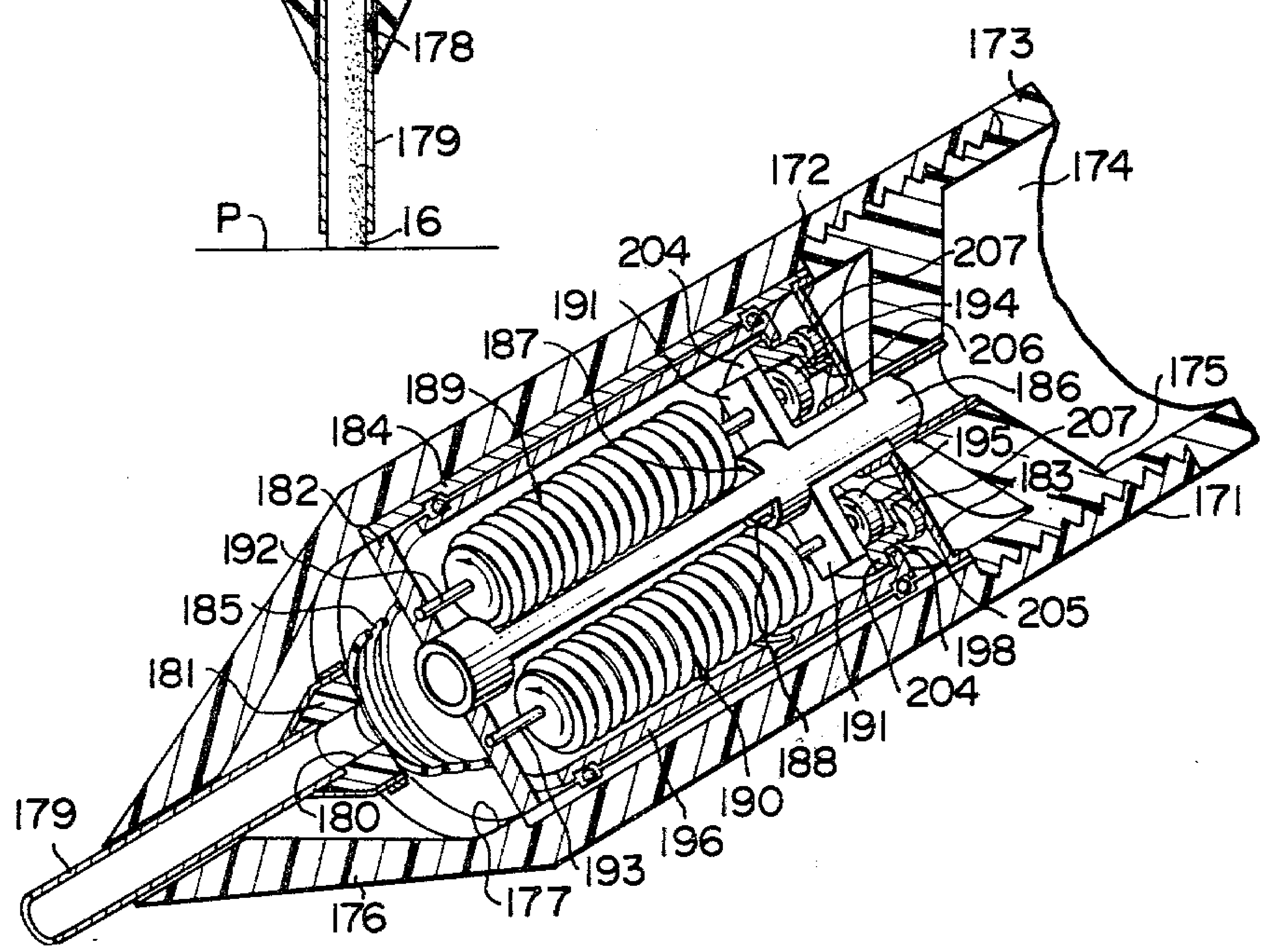
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FIG. 17

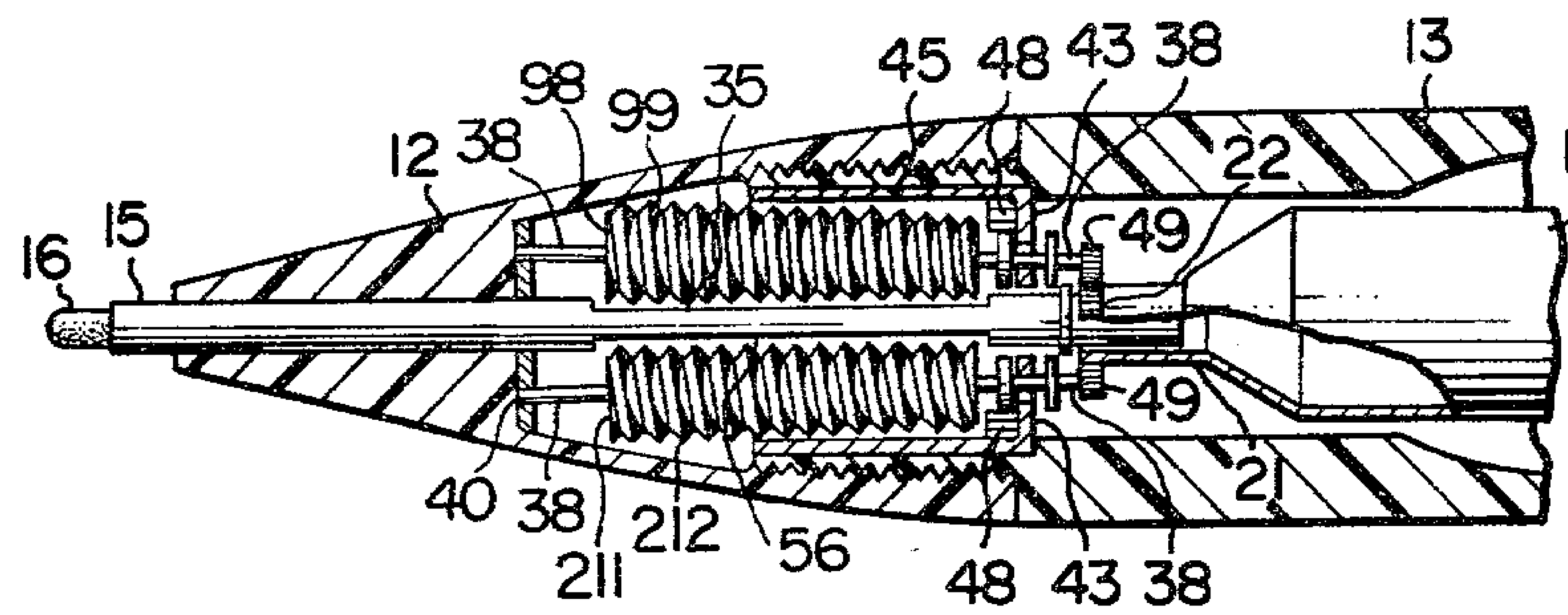
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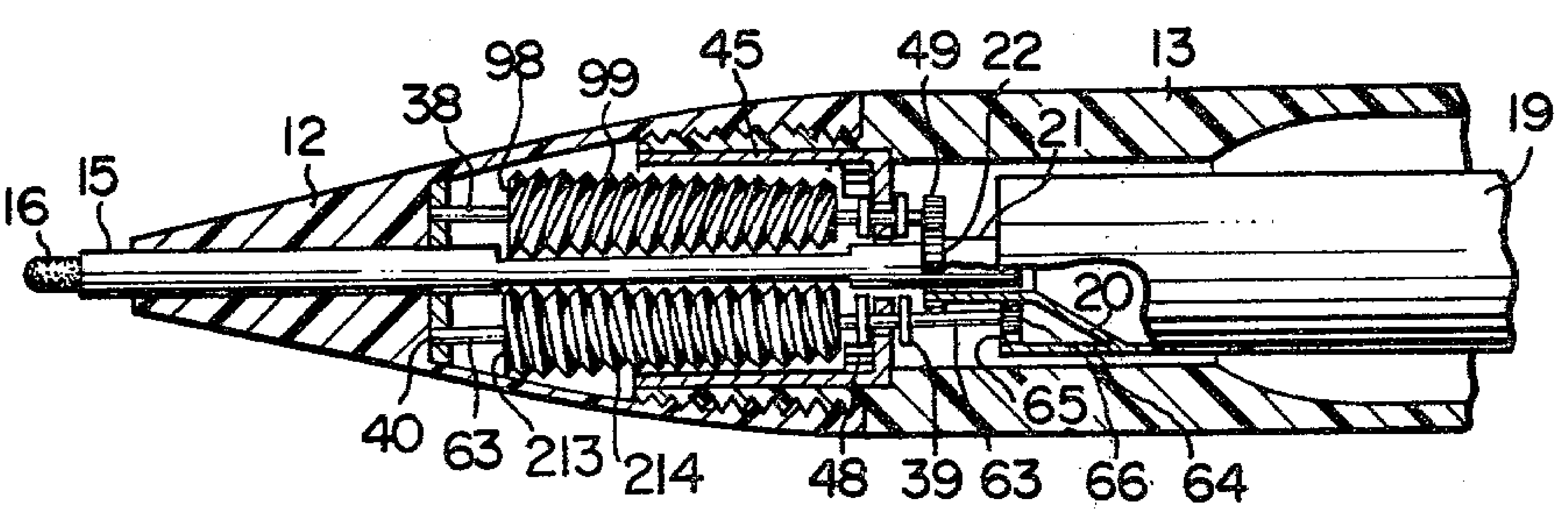
FIG. 18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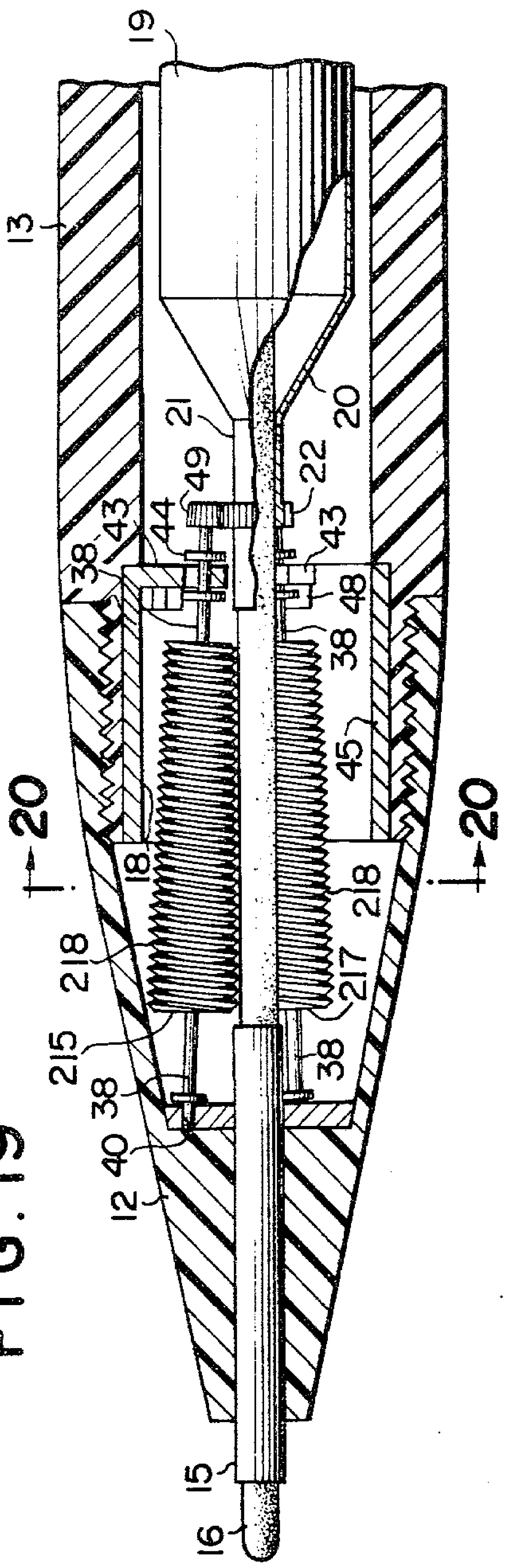
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FIG. 19

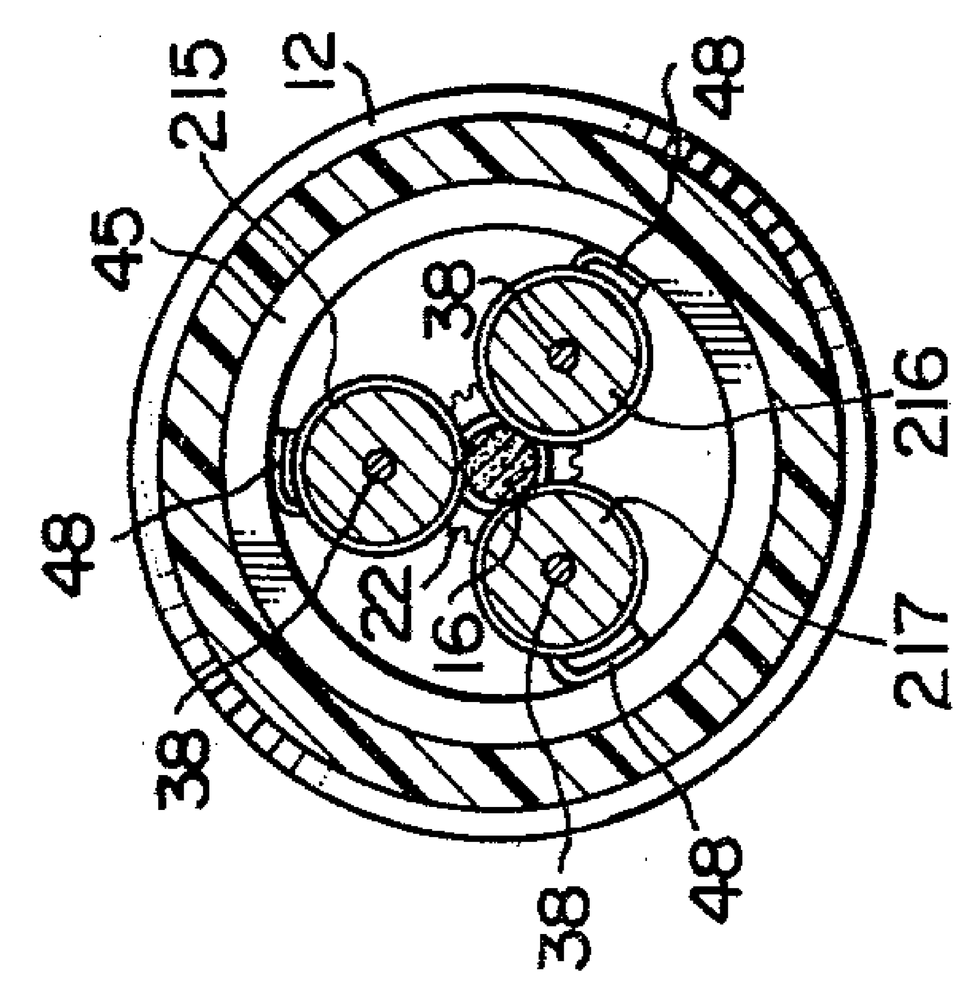
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FIG. 20

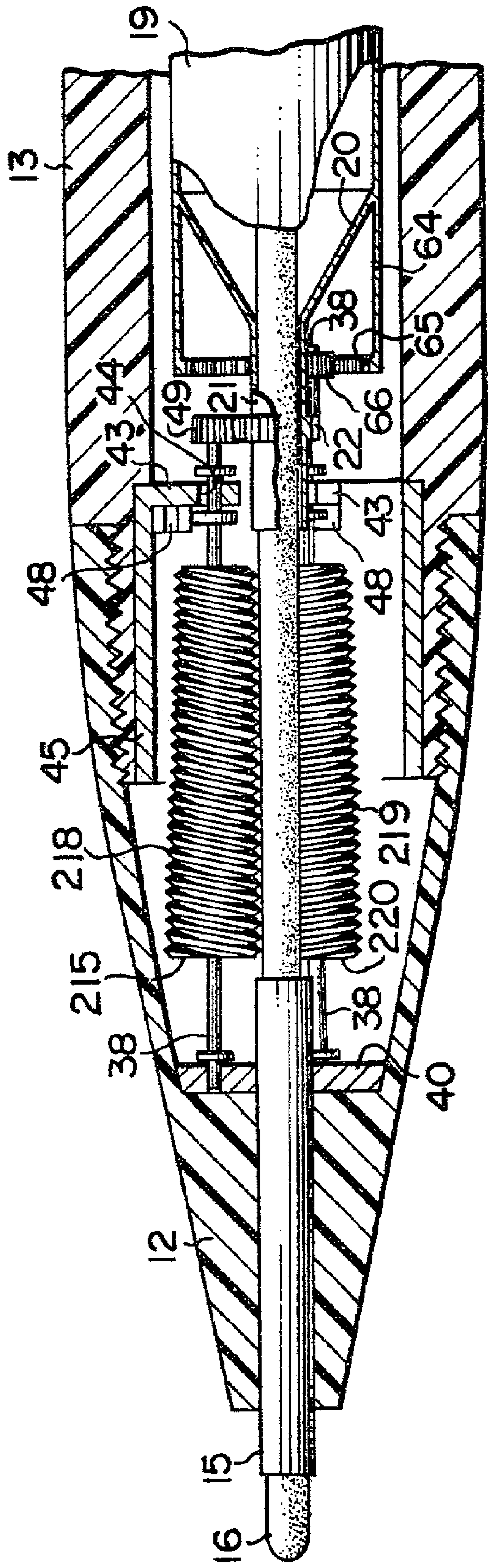

FIG. 21

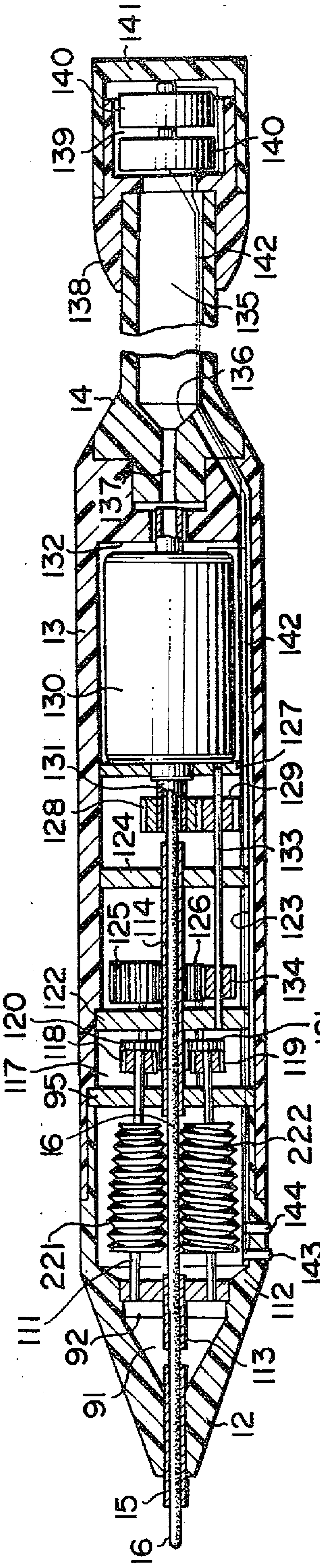

FIG. 22

MECHANICAL PENCIL

FIELD OF THE INVENTION

The invention relates to a mechanical pencil, and more particularly, to a lead feed mechanism of a mechanical pencil in which the advance or retraction of a lead is controlled by the rotation of a lead feed roller which extends substantially parallel to the lead toward the tip end within a casing and having a helical rib formed around its periphery which is adapted to engage the lead.

DESCRIPTION OF THE PRIOR ART

Generally, mechanical pencils are categorized into two types, a rotation fed type and a push fed type, depending on the manner in which the lead is fed. Mechanical pencils of a rotation fed type are disclosed in U.S. Pat. No. 2,722,913 issued to Joseph Aversa on Nov. 8, 1955 and U.S. Pat. No. 3,477,791 issued to Nagahiro Yamashita on Nov. 11, 1969 and assigned to the common assignee as the present application. These mechanical pencils include a casing formed by a pair of coaxially disposed members having an axially extending central bore, a guide pipe disposed within the casing and peripherally formed with a helical slit and which can be rotated within one of the members as the other member is rotated, and a holder pipe loosely fitted inside the guide pipe and having its one end receiving one end of a lead to hold it frictionally. The holder pipe is formed with a projection on its outer periphery which engages with the slit formed in the guide pipe and which also engages a slot formed axially in the inner wall of said one member, whereby the holder pipe is supported against rotation while permitting its axial translation. As the guide pipe rotates, the holder pipe which has its projection engaged with the helical slit in the guide pipe moves axially to permit the lead to project from the tip of the casing or retracted therefrom in accordance with the direction in which the guide pipe is rotated. On the other hand, mechanical pencils of a push fed type are disclosed in U.S. Pat. No. 3,627,434 issued to Yukio Horie on Dec. 14, 1969 and assigned to the common assignee as the present application, for example. Such pencil comprises a collet chuck which is disposed so as to be axially movable within a cylindrical casing and holding a lead, a lead containing sleeve which has its one end connected with the collet chuck and its other end projecting from the rear end of the casing, and spring means which normally urges the lead containing sleeve toward the rear end of the casing. The lead is advanced by pushing the rear end of the lead containing sleeve toward its front end. Specifically, as the sleeve is pushed, the collet chuck moves toward the front end of the casing while carrying the lead, and as it advances through a given distance, the chuck is opened, whereupon the lead is held stationary at its advanced position. When the rear end of the lead containing sleeve is released, the resilience of the spring means returns the sleeve to its original position, whereby the collet chuck returns to its original position while maintaining its open position to catch another lead again.

With a mechanical pencil of rotation fed type, the amount of a rotation can be adjusted to feed a controlled length of lead. However, because the lead must be inserted into one end of the holder pipe one by one, it is necessary to insert a fresh lead into the holder pipe whenever a lead is completely used. By contrast, the

collet chuck and the lead containing sleeve are connected together in a mechanical pencil of push fed type, so that when a lead is completely used, a fresh lead is successively fed into the collet chuck from the sleeve. Hence, it is unnecessary to insert a fresh lead when a lead is completely used as it is required with a mechanical pencil of rotation fed type. However, the length of lead which is fed by a single push operation is predetermined, it is impossible to feed forward a controlled length of lead which is desired by a user.

SUMMARY OF THE INVENTION

It is an object of the invention to provide a mechanical pencil which permits a desired length of lead to be fed forward and in which a pencil lead can be successively fed into the operative position whenever the previous lead is completely used.

In accordance with the invention, there is provided a mechanical pencil comprising a casing having a ferrule at its one end and having a central bore which extends axially thereof, a lead-containing sleeve capable of containing a plurality of leads, the sleeve being adapted to be fitted into the central bore and having its rear end closed by a cover which is detachably mounted on the casing, the front end of the sleeve being narrowed while leaving an opening in alignment with the axis thereof which has a diameter slightly greater than that of the lead, a lead guide pipe mounted in the ferrule so as to be aligned with the axis of the central bore and slidably holding the lead, lead feed means located intermediate the lead guide pipe and the lead-containing sleeve and including at least one lead feed roller having a helical rib on its periphery for engagement with the outer peripheral surface of the lead, drive means for rotating the lead feed roller about its axis, and operating means mounted on the outside of the casing for operating the drive means.

In a preferred embodiment of the invention, a rear casing which forms the rear end portion of the casing is disposed rotatable about the axis of the central bore while the rear end of the lead-containing sleeve is mounted for rotation in ganged relationship with the rotation of the rear casing. The lead feed means comprises a first and a second feed roller, each of which is disposed on the opposite sides of the axis of the central bore to hold the lead therebetween as it is fed into the nip therebetween. The front end of the lead containing sleeve is peripherally formed with annular rack teeth, which mesh with drive gears mounted on the shafts associated with the respective feed rollers. Consequently, as the rear casing is rotated, the rack teeth on the sleeve rotate, whereby the pair of feed rollers rotate in the same direction as they are driven through the drive gears which mesh with the rack teeth. By regulating the rotation of the operating means, a desired length of lead can be fed through the front end of the lead guide. When a lead is completely used, a fresh lead can be fed into the nip between the lead feed rollers from the lead containing sleeve.

In another preferred embodiment of the invention, the lead feed means comprises three feed rollers, one of which is formed with a helical rib which proceeds in the opposite direction from the helical ribs on the remaining two rollers, and hence rotates in the opposite direction from the latter. This prevents a rotation of the lead itself as it is being fed. The drive means may comprise a motor, and a reduction gearing connected with a drive shaft of the motor. In this instance, the operating means may comprise a switch arrangement which is operated to establish a forward or reverse rotation of the motor.

BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** is a longitudinal section, partly broken away, of a mechanical pencil according to a first embodiment of the invention;

FIG. **2** is a perspective view showing a lead feed mechanism of FIG. **1**;

FIG. **3** is a longitudinal section of a lead feed mechanism according to a second embodiment of the invention;

FIG. **4** is a longitudinal section of a lead feed mechanism according to a third embodiment of the invention;

FIG. **5** is a longitudinal section, partly broken away, of a fourth embodiment of the invention;

FIG. **6** is a longitudinal section of a lead feed mechanism according to a fifth embodiment of the invention;

FIG. **7** is a transverse section taken along the line **7—7** shown in FIG. **6**;

FIG. **8** is a transverse section taken along the line **8—8** shown in FIG. **6**;

FIG. **9** is a longitudinal section of a lead feed mechanism according to a sixth embodiment of the invention;

FIG. **10** is a transverse section taken along the line **10—10** shown in FIG. **9**;

FIG. **11** is a longitudinal section, partly broken away, of a seventh embodiment of the invention;

FIG. **12** is a longitudinal section, partly broken away, of an eighth embodiment of the invention;

FIG. **13** is a longitudinal section of a drive transmission mechanism according to a ninth embodiment of the invention;

FIG. **14** is a longitudinal section of a drive transmission mechanism according to a tenth embodiment of the invention;

FIG. **15** is a longitudinal section of a lead feed mechanism according to an eleventh embodiment of the invention;

FIG. **16** is a perspective view, partly in section, of the lead feed mechanism shown in FIG. **15**;

FIG. **17** is a longitudinal section of a lead feed mechanism according to a twelfth embodiment of the invention;

FIG. **18** is a longitudinal section of a lead feed mechanism according to a thirteenth embodiment of the invention;

FIG. **19** is a longitudinal section of a lead feed mechanism according to a fourteenth embodiment of the invention;

FIG. **20** is a transverse section taken along the line **20—20** showing in FIG. **19**;

FIG. **21** is a longitudinal section of a lead feed mechanism according to a fifteenth embodiment of the invention; and

FIG. **22** is a longitudinal section of a lead feed mechanism according to a sixteenth embodiment of the invention.

DESCRIPTION OF PREFERRED EMBODIMENTS

Referring to the drawings, several embodiments of the invention will now be described, and it is to be understood that corresponding parts are designated by like reference numerals throughout the drawings.

Initially referring to FIGS. **1** and **2**, there is shown a first embodiment of the invention. An external casing generally designated by reference numeral **11** includes a front casing **12** which is located foremost and having its front end formed into a tapered ferrule, an intermediate casing **13** having its front end threadably engaged with the rear end of the front casing **12**, and a rear casing **14** which has its front end fitted into the rear end of the intermediate casing **13** by snap action. The various parts of the external casing **11** are molded from a synthetic resin material. The front casing **12** houses a tubular lead guide **15** extending axially in alignment with the axis thereof and which is fixedly carried by the front portion of the front casing **12**. The front end of the lead guide **15** slightly projects beyond the front end of the casing **12** while its other end or rear end is located within the intermediate casing **13**. Lead guide **15** is formed of a metal material, and slidably supports a lead **16** within its bore. Toward its rear end, the front casing **12** is internally provided with a cavity **17** which is concentric with the lead guide **15**. A cavity **18** is formed inside the intermediate casing **13** and extends axially to communicate with the cavity **17**. An open-ended lead-containing pipe **19** having a greater diameter than the lead guide **15** is disposed axially within the cavity **18**, and is formed of a metal material. The purpose of the pipe **19** is to contain spare leads **16** therein. The front portion of the pipe **19** is formed with a front conical surface **20** and a fitting portion **21** which extends horizontally from the front end of the conical surface **20**. The fitting portion **21** has an internal diameter which is slightly greater than the outer diameter of the lead guide **15** so as to be loosely fitted over the rear end of the lead guide **15**. On its front end, the fitting portion **21** is peripherally formed with rack teeth **22**. On its rear end, the intermediate casing **13** is internally formed with a pair of annular rims **23** which extend radially inward. On its front end, the rear casing **14** is internally formed with a hook-shaped projection **25** which extends over the rearmost rim **23** on the intermediate casing **12** to fit between the rims **23** thereon. By fitting the projection **25** on the rear portion of the intermediate casing **13**, the rear casing **14** can be connected with the intermediate casing **13** in a rotatable manner. A cavity **24** is formed within the rear casing **14** and communicates with the cavity **18**, the rear portion of the pipe **19** extending into the cavity **24**. The rear end **26** of the pipe **19** is shaped to present a rectangular cross section so as to be fitted into a rectangular opening **29** formed in the rear end of the cavity **24**, whereby a rotation of the rear casing **14** is positively transmitted to the lead containing pipe **19** to rotate it. The rear end of the rectangular opening **29** communicates with a circular opening **28** which opens into the rear end face of the rear casing **14**. In the example shown, an eraser such as india-rubber **29** is detachably fitted into the opening **28**. The rear end of the eraser **29** is fixed to a protective cap **30**, which can be gripped between fingers to remove the eraser **29**. This permits spare leads to be supplied into the pipe **19**.

Considering now the lead feed mechanism, an axially extending notch **35** having a relatively increased length is formed in the upper portion of the lead guide **15** in its region extending from the opening **17** in the front casing to the cavity **18** of the intermediate casing **13**. An axially extending feed roller **36** is disposed parallel to the axis of the lead guide **15** for engagement with the periphery of the lead **16** which is exposed through notch **35**. The feed roller **36** is peripherally formed with a continuous helical rib **37** which is formed in the manner of a left-hand screw. The feed roller **36** is formed of a metal material such as aluminum or brass or a synthetic resin such as acrylic, polycarbonate or butadienne copolymer resin (ABS). The feed roller **36** is provided with support shafts **38** which extend from its opposite ends. The front shaft **38** is received in an opening **41** formed in a support plate **40** which is rotatably disposed within the front end of the cavity **17**. A movement of the front shaft **38** in the forward direction is limited by a stop ring **42** which is fixedly mounted on the shaft **38**. The rear shaft **38** is received in a slit **44** formed in a holding plate **43**. The slit **44** (see FIG. 2) is formed so as to permit movement of the associated shaft **38** toward the axis of the lead **16**. The upper end of the holding plate **43** is secured to the internal surface of a cylindrical body **45** at its rear end which is fitted into and secured to the front end of the cavity **18** of the intermediate casing **13**. A pair of stop rings **46**, **47** are mounted on the rear shaft **38** so as to hold the plate **43** therebetween. The stop ring **46** engages one limb of a substantially U-shaped leaf spring **48** which has its other limb secured to the internal surface of the cylindrical body **45**. The leaf spring **48** resiliently urges the rear top shaft downward, i.e. toward the axis of the lead guide **15**. It should be understood that the leaf spring may be replaced by any other resilient bias member. A pinion **49** is mounted on the rear end of the rear shaft **38** for meshing engagement with the rack teeth **22** formed on the lead-containing pipe **19**. A stop rib **50** is mounted on the lead guide **15** to limit a movement of the pipe **19** in the axially forward direction.

In operation, the rear casing **14** is rotated counter-clockwise while the foremost end of the front casing **12** is directed downward. This rotation is transmitted through the rear end **16** of the pipe **19** which is fitted into the rectangular opening **27** in the rear casing **14** in a positive manner, thus causing a counter-clockwise rotation of the pipe **19**. Such rotation of the pipe **19** is transmitted to the pinion **49** through the rack teeth **22**, whereby the pinion **49**, and hence the feed roller **36**, rotates clockwise. When the rib **37** on the feed roller **36** is helically formed in the manner of a left-hand screw, the helix will move to the left, as viewed in FIG. **1**. On the other hand, one of the leads **16** contained in the pipe **19** will slide along the front conical surface **20** to be dropped into the lead guide **15** where it will be engaged by the rear end of the feed roller **36**. It is to be noted that both axial ends of the feed roller **36** have a reduced diameter as is usually found in a screw, so that the leading end of the lead **16** is initially engaged by such portion of the feed roller **36** having a reduced diameter, allowing the outer end of the rib **37** to bite lightly into the outer periphery of the lead **16**. Once such biting action occurs, the lead **16** causes the feed roller **36** to be driven outward, or upward as viewed in FIG. **1**, against the resilience of the leaf spring **48**. Subsequently, a clockwise rotation of the feed roller **36** enables the lead **16** to move down, or to the left as viewed in FIG. **1**. A cut of a small depth is formed in the periphery of the lead **16** by the rib **37**. The cut progresses in the opposite direction from the rib **37**, namely, in the manner of a right-hand screw in the present example, thus enabling a positively controlled movement of the lead **16** to the left. After the rib **37** on the feed roller **36** has engaged the lead **16**, a continued rotation of the rear casing causes the lead **16** to advance further forward, whereby the leading end of the lead **16** projects beyond the front end of the lead guide **15**. Because the leaf spring **48** maintains the feed roller **36** in abutment against the periphery of the lead **16**, a retraction of the lead **16**, namely, its movement to the right, as viewed in FIG. **1**, during the writing process is prevented. When it is desired to retract the lead **16**, the rear casing **14** may be rotated clockwise. The clockwise rotation of the casing **14** causes a counter-clockwise rotation of the feed roller **36**, whereby the lead **16** is moved to the right, as viewed in FIG. **1**. When the initial lead **16** is completely used as a result of a writing process, another spare lead contained in the pipe **19** is successively fed into the lead guide **15**.

The amount through which the lead **16** is fed forward is determined by the pitch of the feed roller **36** and the turn ratio of the rack teeth **22** and the pinion **49**. By way of example, when the feed roller **36** has a pitch of 0.4 mm and one revolution of the rack **22** permit three revolutions of the pinion **49**, a rotation of the rear casing **14** through one-third revolution causes the lead to be fed forward 0.4 mm. It is to be noted that the amount of feed can be controlled continuously, so that it is a simple matter to feed forward a desired length of the lead by adjusting the amount of rotation of the rear casing **14**. In this embodiment, the helical rib **37** on the feed roller **36** is formed in the manner of a left-hand screw, so that a counter-clockwise rotation of the rear casing **14** feeds the lead **16** forward. However, when the rib on the feed roller is formed in the manner of a right-hand screw, the rear casing may be rotated in clockwise to feed the lead forward.

Referring to FIG. **3**, there is shown a second embodiment of the invention in which an additional feed roller **55** is provided. The two feed rollers **36**, **55** are disposed to hold the lead **16** therebetween while feeding it forward. Specifically, the second feed roller **55** is disposed parallel to the feed roller **36** at an angular position which is 180° spaced from the feed roller **36** relative to the axis of the lead guide **15**. The lead guide **15** is additionally formed with a second notch **56** which is 180° spaced from the first mentioned notch **35** to expose the part of the lead **16** therethrough. A helical rib **57** is formed on the periphery of the second feed roller **55** in the manner of a left-hand screw in the same manner as the feed roller **36**, whereby the rib **57** is adapted to engage the peripheral surface of the lead **16** which is exposed through the second notch **56**. The support of and a rotation transmission mechanism for the second feed roller **55** are similar to those described above in connection with the first embodiment, and therefore will not be described specifically.

In operation, when the rear casing **14** (FIG. **1**) is rotated counter-clockwise, the lead-containing pipe **19** also rotates in the same direction. The rotation of the pipe **19** causes the two pinions **49** to rotate clockwise, advancing the lead **16** to the left, as viewed in FIG. **3**. A smooth feeding operation for the lead **16** is assured by holding the lead **16** between the two feed rollers **36**, **55**. Because the lead **16** is urged in two directions, the grip on the lead **16** as well as the force to feed the lead **16** by the rollers **36**, **55** can be increased.

In an embodiment shown in FIG. **4**, the second feed roller **55** of the second embodiment is replaced by a reversing roller **62** having a helical rib **61** which proceeds in the opposite direction. Specifically, the rib **61** on the reversing roller **62** is formed in the opposite direction from the rib on the feed roller **36**, that is to say, in the manner of a right-hand screw. The reversing roller **62** carries a rear support shaft **63** which extends through the holding plate **43** to the rear side thereof. The lead-containing pipe **19** is formed with an extension

64 which extends parallel to the axis thereof so as to cover the front conical surface 20 thereof. On its front end, the extension ring 64 is internally formed with annular rack teeth 65, which mesh with a pinion 66 mounted on the rear end of the rear shaft 63. The standard pitch circle of the rack teeth 65 has a diameter which is twice the diameter of the standard pitch circle of the rack teeth 22, so that the feed roller 37 is formed as double-threaded screw in order to increase the pitch of the feed roller 37 will be twice the pitch of the reversing roller 62.

In the operation of this third embodiment, when the rear casing 14 is rotated counter-clockwise, the pinion 49 rotates clockwise in the same manner as in the previous embodiment. On the other hand, the pinion 66 rotates counter-clockwise as a result of its meshing engagement with the rack teeth 65 on the extension ring 64. Consequently, the feed roller 36 and the reversing roller 62 rotate in the opposite direction. Though the reversing roller 62 rotates in the opposite direction, the rib 61 formed thereon in the manner of a right-hand screw permits the lead 16 to be fed to the left, as viewed in FIG. 3. Consequently, the two rollers 36, 62 feed the lead 16 forward while firmly holding it therebetween. The rotation of the pair of rollers 36, 62 in the opposite directions permits the lead 16 to be fed forward without causing its rotation.

FIG. 5 shows a fourth embodiment of the invention in which the lead-containing pipe is formed integrally with the rear casing and an initial engagement between the feed roller and the lead is assured. Specifically, a rear casing 71 includes a cylindrical extension 72 which extends into the cavity 18 of the intermediate casing 13, with the front portion of the extension 72 being formed into a front conical portion 73. At its opposite end, the extension 72 is peripherally formed with an annular groove 78 in which the annular rim 25 formed on the rear end of the intermediate casing 13 is fitted, thus allowing a rotation of the rear casing 71 relative to the intermediate casing 13. The rear end of the lead guide 15 is fitted into the front end of the conical portion 73 so as to be supported thereby. Rack teeth 22 are formed on the outer periphery of the front portion of the conical portion 73 for meshing engagement with the pinion 49. In this manner, a cavity 74 of the rear casing 71 can be utilized for containing spare leads, allowing an increased number of leads 16 to be contained therein as compared with a separate lead-containing pipe 19 which has been used in the previous embodiments. In addition, the construction is simplified. Furthermore, a feed roller 75 of this embodiment includes a tapered portion 76 of a diameter which gradually decreases toward its rear end, and a helical rib 77 is formed over the length of the roller 75 from its tapered portion 76 to its front end. Consequently, a lead 16 which is supplied from the cavity 74 within the rear casing 71 is initially engaged by the tapered portion 76 of the feed roller, assuring a smooth initial engagement between the leading end of the lead 16 and the feed roller 75.

FIGS. 6 to 8 show a fifth embodiment of the invention in which three feed rollers are employed to feed a lead forward. Specifically, three feed rollers 81, 82, 83, each of which is constructed in the same as manner the feed roller shown in connection with the first embodiment, are spaced apart at an equal angular interval of 120° about the axis of the cavity 18 formed in the intermediate casing 13 so as to surround the lead 16. It will be noted that only two rollers are shown in FIG. 6. A helical rib 84 formed on each roller proceeds in the same direction, that is, is formed as a left-hand screw. The manner in which the individual rollers 81, 82, 83 are supported, and the transmission mechanism by which a rotating drive is transmitted thereto remain the same as those mentioned above in connection with the feed roller 36 of the first embodiment, and therefore will not be specifically described. As shown, the lead 16 is supported by three feed rollers 81, 82, 83, so that the rear end of the lead guide 15 need not extend to the fitting portion 21 of the lead containing pipe 19. Instead, the rear end of the lead guide 15 is located close to the front end of the feed rollers 81 to 83. On the other hand, the fitting portion 21 of the lead containing pipe 19 has an internal diameter which is substantially equal to the internal diameter of the lead guide 15.

As a lead 16 is fed forward from the fitting portion 21 of the pipe 19, it is surrounded by three feed rollers 81 to 83, so that when the pipe 19 is rotated, the three feed rollers 81 to 83 engage the outer periphery of the lead 16 while rotating. Thereupon, the lead 16 is advanced axially forward while slightly spreading the rollers 81 to 83 outward against the resilience of the leaf spring 48. While the lead guide 15 is spaced from the lead-containing sleeve 19 in the present embodiment, the lead cannot move away from any of the rollers because it is surrounded by three rollers.

FIGS. 9 and 10 show a sixth embodiment of the invention where one of the three feed rollers shown in the fifth embodiment is replaced by a reversing roller which has been described above in connection with the third embodiment. Specifically, the feed roller 83 of the fifth embodiment is replaced by a reversing roller 87 having a helical rib 86 which proceeds in the opposite direction. The configuration of the reversing roller 87 and a mechanism which transmits rotation thereto are constructed in the same as the reversing roller 62 described above, and hence will not be described specifically. As before, this arrangement prevents a rotation of the lead 16.

In the fifth and the sixth embodiments, there have been provided three feed rollers. However, it should be understood that four feed rollers may be disposed at an equal angular interval of 90° about the axis of the cavity 18 of the intermediate casing 13. In this instance, two of these rollers may be formed by reversing rollers as illustrated in the third and the sixth embodiments. By increasing the number of feed rollers, the area of contact between the feed rollers and the lead increases, increasing the grip of the feed rollers on the lead.

FIG. 11 shows a seventh embodiment of the invention. In this embodiment, the feed roller is frusto-conical in configuration and has an axis which is disposed at an angle with respect to the axis of the lead guide in a plane which includes the latter. The feed roller is disposed so as to be movable in the axial direction so that the grip on the lead can be varied in accordance with the magnitude of the writing pressure.

Specifically, referring to FIG. 11, the lead guide 15 extends through the front portion of the front casing 12, and has its rear end located within a conical opening 91 formed in the front casing 12. The axis of the conical opening 91 coincides with the axis of the lead guide 15, with its apex located nearer the front end of the lead guide 15. Also formed in the front casing 12 are a support opening 93 which communicates with the rear end of the conical opening 91 and in which a front support plate 92 having its peripheral surface extending parallel to the axis of the lead guide **15** is rotatably fitted, and a roller opening **94** having a greater diameter than the support opening **93**. The rear end of the roller opening **94** is closed by a rear support plate **95**, which is threadably engaged with the front end of the intermediate casing **13** together with the rear end of the front casing **12**. A lead support pipe **96** extends through the front and the rear support plates **92**, **95** in aligned relationship with the axes of these support plates. An axially extending notch **97** is formed in the upper surface of the lead support pipe **96**. The front end of the lead support pipe **96** is spaced from the rear end of the lead guide **15** while the rear end of the pipe **96** is located in a forward portion of the front conical portion **22** of the lead-containing pipe **19**. Consequently, a lead **16** can be fed from the lead-containing pipe **19** through the lead support pipe **96** into the lead guide **15**. A feed roller **98** is located above the notch **97** in the lead support pipe **96**, and is disposed so that its peripheral surface engages the peripheral surface of the lead **16** which is exposed through the notch **97**. As shown, the feed roller **98** is in the form of a frustum of a cone which increases in diameter from its rear end toward its front end. A helical rib **99** is formed on the peripheral surface of the feed roller **98** in the manner of a right-hand screw. The feed roller **98** carries support shafts **100** which are disposed at an angle with the axis of the lead support pipe **96** in a plane which includes the latter axis. It will be noted that the opposite ends of the support shafts **100** are carried by the front and the rear support plates **92**, **95** in a manner such that they can be slightly moved along their axes to permit the feed roller **98** to bite into the lead as a writing pressure is applied thereto, as will be further described later. At this end, the front support plate **92** is formed with a support cavity **104** which is provided to support the front support shaft **100** and which has a length to permit a movement thereof. A gear **66** is mounted on the rear support shaft **100** for meshing engagement with the internal rack teeth **65** on the extension ring **64** of the lead-containing pipe **19**, in the same manner as described above in connection with the fourth embodiment. Thus, the feed roller **98** is constructed in the same manner as the reversing roller shown in the fourth and sixth embodiments. However, in the present embodiment, the intermediate casing **13** is internally formed with an annular projection **101** toward its rear end which projects radially inward for engagement with a detent projection **102** which is formed on the outer periphery of the lead containing pipe **19** to extend radially outward, thus limiting a forward movement of the pipe **19**. Additionally, a protective cap **103** which retains an eraser **29** has an outer periphery which is sized to be coincident with the outer periphery of the rear casing **14**.

In operation, the feed roller **98** rotates as the rear casing **14** is rotated in the same manner as in the fourth and sixth embodiments. As the leading end of the lead **16** is engaged by the rear end of the feed roller **98**, the latter moves forward until the front end of the front support shaft **100** bears against the bottom of the cavity **104**. When such forward movement is interrupted, the feed roller **98** engages the lead **16**. The rotation of the rear casing **14** is stopped when a desired length of the lead **16** is exposed through the front of the lead guide **15**, whereby the pencil is in condition for writing. When the lead **16** is applied against a writing surface, the writing pressure imparts a force to the lead **16** which tends it to be retracted rearwardly. However, because the rib **99** on the feed roller **98** abuts against the peripheral surface of the lead **16** and the support shafts **100** of the feed roller **98** assume an inclined position such that the axis of the lead **16** is more closely approached as they are moved rearward, only a slight retraction of the feed roller **98** occurs to bite into the lead **16** as the latter also retracts slightly, in response to the writing pressure applied to the lead. The amount of such retraction is determined by a further bite of the rib **99** into the lead and the angle of the inclination of the shafts **100**, but can be kept below 0.01 mm, and hence presents no difficulty for practical purposes. In this manner, a grip on the lead **16** is assured in accordance with the writing pressure.

While the feed roller **98** is formed as a reversing roller in the present embodiment, it may be designed to rotate in the forward direction by providing a helical rib thereon which is formed as a left-hand screw in the manner mentioned above in connection with the first embodiment. Alternatively, instead of movably disposing the support shafts on the front support plate, the axial movement of the feed roller may be achieved by providing an axially extending groove in the support shaft to permit a displacement of the feed roller along the groove.

FIG. **12** shows an eighth embodiment of the invention in which a motor is used to supply a rotating drive. As is the seventh embodiment, the front and the rear support plates **92**, **95** are disposed within the front casing **12**, and a pair of support shafts **111**, **112**, which are 180° spaced apart with respect to the axis of the lead **16**, extend between and are rotatably mounted on the plates **92**, **95**. A lead support pipe **113** is mounted on the front support plate **92** in alignment with the axis of the lead guide **15**. A lead feed pipe **114** which is disposed in alignment with the axis of the support pipe **113** has its one end supported by the rear support plate **95**, and has its rear end extending through the intermediate casing **13**. A feed roller **115** of the same construction as the feed roller **75** mentioned above in connection with the fourth embodiment is mounted on the support shaft **111** while a reversing roller **116** having a helical rib which is formed in the manner of a right-hand screw, and thus proceeds in the opposite direction from the feed roller **115**, is mounted on the support shaft **116**. The lead **16** which is delivered from the lead feed pipe **114** is fed into the lead support pipe **113** while it is being carried between the pair of rollers **115**, **116**.

The rear ends of the support shafts **111**, **112** extend through the rear support plate **95** and project into a cavity **117** formed within the intermediate casing **13**, with pinion gears **118**, **119** being mounted on their free end. The gear **118** meshes with a reduction gear **120** which is disposed within the cavity **117** while the gear **119** meshes with a reduction gear **121**. It is to be noted that the reduction gears **120** and **121** are maintained in meshing engagement with each other. Consequently, if the reduction gear **120** rotates clockwise, the gear **118** also rotates clockwise while the gear **119** rotates counter-clockwise. Hence, it will be appreciated that the feed roller **115** and the reversing roller **116** positively feed the lead **16** to the left, as viewed in FIG. **12**, in the same manner as mentioned above in connection with the third embodiment. The reduction gears **120**, **121** are rotatably supported in a partition **122** which is fitted into the rear end of the cavity **117** and which also supports the lead feed pipe **114** its central region. The rear surface of the partition **122** defines a front end of a cavity **123** which continues toward the rear end of the intermediate casing **13**. The cavity **123** has a more reduced diameter than the cavity **117**, whereby a rearward movement of the partition **122** is constrained. An abutment plate **124** is disposed within the cavity **123** at an axial spacing from the partition **122**, and carries the rear end of the lead feed pipe **114**. A second reduction gear **125** which is disposed in coaxial alignment with the reduction gear **120**, and a third reduction gear **126** of a reduced diameter which meshes with the gear **125** are located intermediate the partition **122** and the abutment **124**. A retainer plate **127** is disposed at an axial separation from the abutment plate **124**, and a drive gear **128** and a drive reduction gear **129** which meshes therewith are located intermediate the abutment plate **124** and the retainer plate **127**. The drive gear **128** is mounted on a drive shaft **131** of a motor **130**, which is received in the cavity **123** between the retainer plate **127** and the rear end wall **132** of the intermediate casing **13**. The drive shaft **131** comprises a hollow shaft with its axis aligned with the axis of the lead feed pipe **114**. A miniature motor which can be fitted into the cavity **123** is desirably used for the motor **130**, and is available from Namiki Seimitsu Hoseki K.K. In Japan as model 10CL-1200, for example. This motor has an outer diameter of about 10 mm and is of a coreless type. The rear end of the drive shaft **131** extends to the rear end of the intermediate casing **13**. The drive reduction gear **129** is mounted on a shaft **133**, the front end of which is rotatably supported by the partition **122** and the rear end of which is rotatably supported by the retainer plate **127**. A transmission gear **134** is mounted on the front portion of the shaft **133** for transmitting the rotation of the shaft **133** to the third reduction gear **126**.

The rear casing **14** is mounted on the rear end of the intermediate casing **13**, and is formed with an axially extending lead-containing bore **135** therein. The front end of the bore **135** is formed into a front conical surface **136**, and a lead passage **137** provides a communication between the front end of the conical surface **136** and the front end of the rear casing **14**. In this manner, leads **16** contained in the bore **136** can be fed one by one into the hollow shaft **131** through the lead passage **137**. A battery-containing sleeve **138** is detachably fitted over the rear end of the rear casing **14** so as to close the rear end of the bore **135**. The sleeve **138** has a space **139** therein in which batteries **140** are received. A cap **141** is threadably engaged with the rear end of the sleeve **138**, and the cap **141** can be unscrewed to enable a replacement of the batteries **140**. It is to be noted that the batteries **140** are connected with miniature switches **143**, **144** mounted in the wall of the front casing **12** as well as the motor **130** through lead wires **142**. Switch **143** can be operated to rotate the motor **130** in the forward direction while the switch **144** can be operated to rotate the motor **130** in the reverse direction. These switches are formed by pushbutton switches of non-lock type, such switches are well known, for example the numerical or control switches mounted on the electronic wristwatch with an electronic calculator such as DPZ010 type which is commercially available from Kabushiki Kaisha Seikosha of Japan.

When the switch **143** is depressed with a finger, the motor **130** rotates in the forward direction. This rotation is transmitted through drive shaft **131**, drive gear **128**, and drive reduction gear **129** to the shaft **133**, which then rotates in the opposite direction. The rotation of the shaft **133** is transmitted through the transmission gear **134**, third reduction gear **126**, and the second reduction gear **125** to rotate the reduction gear **120** in the forward or clockwise direction, thus causing a rotation of the feed roller **115** and the reversing roller **116** to feed the lead **16** to the left, as viewed in FIG. **12**.

FIG. **13** shows a ninth embodiment of the invention, illustrating a modification of the drive transmission mechanism shown in FIG. **12**. Specifically, the rear casing **14** is formed with only a lead containing bore **135**, and a motor casing **151** which houses a motor **130** and a battery **140** is mounted on the rear end of the rear casing **14**. The opposite ends of the motor **130** are fixed in position by retainer plates **152**, **153**, and the battery **140** is located on the opposite side of the retainer plate **153**. The retainer plate **152** is centrally formed with an opening through which the drive shaft **154** of the motor **130** extends, and a drive gear **128** is mounted on the drive shaft **154** which projects through the retainer plate **153**. A drive reduction gear **129** meshes with the drive gear **128**, and is mounted on a shaft **133** which extends through a plate member **155** blocking the rear end of the lead containing bore **135** and which extends into the interior of the intermediate casing **13**. The plate member **155** is centrally formed with an opening **156** through which leads **16** are inserted.

FIG. **14** shows a tenth embodiment of the invention in which a motor and a power supply are separately provided. Specifically, a flexible shaft **162** is connected with the rear end of the shaft **133** through a sleeve coupling **161**. The flexible shaft **162** extends from the rear part of the intermediate casing **13** to the exterior thereof. The other end of the flexible shaft **162** is connected with the drive shaft **154** of the motor **130**, housed within a separate motor casing **163**, through a sleeve coupling **164**. The motor casing **163** houses the motor **130** and the battery **140**, and a cap **165** is detachably mounted on the end of the motor casing which is nearer the battery **140**. In the present embodiment, it is only necessary that the rear casing **14** be formed with the lead containing bore **135**, with a lead cap **166** detachably fitted over the rear end of the rear casing **14** to close the lead containing bore **135**. The flexible cable **162** is provided with a protective tube **167**.

In the eighth to tenth embodiments described above, it is possible to feed the lead **16** about 0.4 mm forward by one touch of the switch **143** when the motor **130** has a number of revolutions of 2,000 rpm, the transmission gearing has a speed reduction ratio of 1/75, and the feed roller **115** and the reversing roller **116** have a pitch of 0.4 mm.

FIGS. **15** and **16** show an eleventh embodiment of the invention in which the lead is fed forward by interrupting the writing process and the tip of the mechanical pencil is moved away from a writing surface to release the writing pressure.

Specifically referring to these Figures, the mechanical pencil comprises a casing body **171** which includes a front casing **172**, and a rear casing **173** which has its front end threadably engaged into the rear end of the front casing **172**. The rear casing **173** is internally formed with a lead-containing bore **174**, the forward of which is shaped into a front conical surface **175** which is centrally formed with an opening.

The forward portion of the front casing **172** is shaped into a tapered ferrule **176** defining a space **177** which continues to the rear end of the front casing **172**. At its tip, the ferrule **176** is centrally formed with a through-opening **178** in which a lead guide **179** is slidably disposed for supporting a lead **16** in a slidable manner. The lead guide **179** has a sufficient length such that its front end projects through the ferrule **176** while its rear end extends into the space **177**. A spring abutment **181** having an opening **180** formed therein which communicates with the hollow interior of the lead guide **179** is mounted on the rear end thereof. Fitted into the space **177** and secured therein is a cylindrical body **184** which has its opposite ends closed by sideplates **182, 183**. A coiled spring **185** is mounted between the spring abutment **181** and the sideplate **182** for normally urging the lead guide **179** outward, namely, to the left as viewed in FIG. **16**. A lead feed pipe **186** having its axis aligned with the axis of the lead guide **179** is passed through openings formed in the both sideplates **182, 183** so as to be supported thereby. A pair of axially extending notches **187, 188** are formed in the peripheral wall of the lead feed pipe **186** and are spaced apart 180° around the axis thereof, thereby exposing the lead **16**. The rear end of the lead feed pipe **186** extends into the central opening formed in the front conical surface **175**. In this manner, a lead from the lead-containing bore **174** can be delivered through the lead feed pipe **186** and fed forward from the front end of the lead guide **179**. A first feed roller **189** is located adjacent to the notch **187** while a second feed roller **190** is located adjacent to the notch **188**. These rollers **189, 190** are constructed in the same manner as the rollers **36, 55** described above in connection with the second embodiment. In a region between the sideplate **183** and the notches **187, 188**, a pair of L-shaped support plates **191** are mounted on the lead feed pipe **186** such that one of their limbs extend parallel to the plane of the sideplate **183**. The pair of rollers **189, 190** are mounted on support shafts **192, 193**, respectively, the opposite ends of which are rotatably supported by the sideplate **182** and the support plates **191**. The end of the respective support shafts **192, 193** which is located nearer the support plates **191** extends therethrough, with transmission rollers **194, 195** mounted on the free end thereof.

A rotating cylinder **196** is fitted inside the cylindrical body **184** with a very small clearance therebetween. To assure a smooth rotation of the cylinder **196**, ball bearings **197** are interposed between the cylindrical body **184** and the cylinder **196** at a suitable interval. The rear end of the cylinder **196** is located rearwardly of a surface of the support plates **191** which supports the support shafts **192, 193**, and is internally formed with an annular projection **198**. The cylinder **196** is internally formed with a helical groove **199** across its length, and a rotating roller **200** fits in the groove **199**. The roller **200** is rotatably mounted on one end of a connecting bar **201**, the other end of which extends through an opening **202** formed in the sideplate **182** to be connected with the spring abutment **181**. The opening **202** has a diameter which is slightly greater than the outer diameter of the connecting bar **201** so as to permit only a vertical movement of the connecting bar **201**. Consequently, if the lead guide **179** is brought into abutment against a writing surface P and is raised, the connecting bar **201** is also raised, whereby the roller **200** moves along the groove **199**. However, the opening **202** prevents the connecting bar **201** from rotating. As a consequence, the upward movement of the connecting bar **201** imparts a rotating force to the cylinder **196**.

A hollow, rotation transmitting cylinder **203** is fitted into the rear end of the cylinder **196**. It comprises a detent flange **204** of a diameter which is less than the internal diameter of the cylinder **196**, but is greater than the internal diameter of the annular projection **198**, a cylindrical portion **205** of a diameter which is slightly less than the internal diameter of the annular projection **198**, and a cylindrical engaging portion **206** having an outer diameter which is less than the outer diameter of the cylindrical portion **205**, all connected together in an integral manner. A downward movement, as viewed in FIG. **15**, of the detent flange **204** is limited by abutment against the support plates **191** while its upward movement is limited by abutment against the annular projection **198**. The internal surface of the cylindrical portion **205** is maintained in engagement with transmission rollers **194, 195**, whereby the rotation of the hollow cylinder **203** causes the transmission rollers **194, 195** to rotate. The outer periphery of the engaging portion **206** is maintained in engagement with a plurality of auxiliary rollers **207** which are rotatably mounted on the sideplate **183**. The purpose of these auxiliary rollers **207** is to assure a smooth rotation of the hollow cylinder **203**. The opposing surfaces of the annular projection **198** and the detent flange **204** are formed to exhibit a high coefficient of friction so that when they are held in abutment, the rotation of the cylinder **196** is positively transmitted to the cylinder **203**. By way of example, these surfaces may be lined with rubber or threaded.

When the lead guide **179** is brought into abutment against the writing surface P to be raised upward, the rotating roller **200** functions to push up the lower end of the groove **199**, so that a clearance is formed between the annular projection **198** and the detent flange **204**. Hence, a rotation of the cylinder **196** does not cause a rotation of the hollow cylinder **203**. When the tip of the lead guide **179** is released from the writing surface, the resilience of the spring **185** urges the spring abutment **181** downward. As the abutment **181** is pushed back, the roller **200** moves downward along the groove **199** while maintaining its engagement with a lower region of the groove **199**. This movement imparts an opposite rotation to the cylinder **196**. On the other hand, when the rotating roller **200** engages the lower end of the groove **199** and the cylinder **196** is urged to move downward, the detent flange **204** is brought into contact with the annular projection **198**, whereby the rotation of the cylinder **196** is transmitted to the hollow cylinder **203**, thus rotating it. In response thereto, the transmission rollers **194, 195** rotate in the same directions, causing the first and second feed rollers **189, 190** to rotate. The rotation of the rollers **189, 190** feeds the lead **16** forward as mentioned above in connection with the second embodiment. The rollers **189, 190** continue to rotate until the spring abutment **181** abuts against the front wall which defines the space **177**. In this manner, with this embodiment, the arrangement that the lead guide **176** is axially movable permits the writing process to be continued while raising the lead guide **176**. When the lead guide **176** is released from the writing surface P after it is raised through a certain stroke, the lead **16** is automatically fed forward.

FIG. **17** shows a twelfth embodiment of the invention in which the two feed rollers **36, 55** of the second embodiment are replaced by the feed roller **98** of the seventh embodiment respectively. A second feed roller **211** is disposed parallel to the feed roller **98** at an angular position which is 180° spaced from the feed roller **98** relative to the axis of the lead guide **15**. A helical rib **212** is formed on the periphery of the second feed roller **211** in the manner of a left-hand screw in the same manner as the feed roller **98**. The support of and rotation transmission for the second feed roller **211** are similar to those described above in connection with the second embodiment. By this arrangement, the grip on the lead **16** as well as the force to feed the lead **16** by the rollers **98, 211** can be increased, and further the grip on the lead can be varied in accordance with the magnitude of the writing pressure.

In an embodiment shown in FIG. **18**, the second feed roller **211** of the twelfth embodiment is replaced by a reversing roller **213** having a helical rib **214** which proceeds in the opposite direction from the helical rib **99** on the feed roller **98**. The support of and rotation transmission for the reversing roller **213** are similar to those described above in connection with the second embodiment shown in FIG. **4**.

FIGS. **19** and **20** show a fourteenth embodiment in which three feed rollers are employed to feed a lead forward. Specifically, three feed rollers **215, 216, 217**, each of which is constructed in the same manner as the feed roller **98** shown in the seventh embodiment, are spaced apart at an equal interval of 120° about the axis of the cavity **18** formed in the intermediate casing **13** so as to surround the lead **16**. A helical rib **218** formed on each roller proceeds in the same direction, that is, is formed as a left-hand screw. The manner in which the individual rollers **215, 216, 217** are supported, and the transmission mechanism by which a rotating drive is transmitted thereto, are the same as those mentioned above in connection with the fifth embodiment.

FIG. **21** shows a fifteenth embodiment of the invention where one of the three feed rollers shown in the fourteenth embodiment is replaced by a reversing roller which has been described above in connection with the thirteenth embodiment. Specifically, the feed roller **217** of the fourteenth embodiment is replaced by a reversing roller **220** having a helical rib **219** which proceeds in the opposite direction from that of the other feed rollers. The configuration of the reversing roller **220** and mechanism which transmits rotation thereto are constructed the same as the reversing roller **62** described above.

FIG. **22** shows a sixteenth embodiment in which the rollers **115, 116** of the eighth embodiment are replaced by rollers **221, 222** similar to the rollers **98** and **213** shown in FIG. **18**. The support of and a rotation transmission for the rollers **221, 222** are similar to those described above in connection with the eighth embodiment, and hence will not be described specifically.

What is claimed is:

1. A mechanical pencil comprising: a casing having a ferrule at its one end and having a central bore which extends axially thereof; a lead-containing sleeve capable of containing a plurality of leads and fitted into the central bore and having its rear end closed by a cover which is detachably mounted on the casing, the front end of the sleeve having a narrowed portion having an opening in alignment with the sleeve axis and a diameter slightly greater than that of the lead; a lead guide pipe mounted in the ferrule so as to be aligned with the axis of the central bore and slidably holding the lead; lead feed means located intermediate the lead guide pipe and the lead-containing sleeve and including at least one lead feed roller having a helical rib on its periphery for engagement with the outer peripheral surface of the lead, said feed roller having a frusto-conical configuration with its axis located in a plane which includes the axis of the lead guide and which is disposed at an angle with respect to the axis of the lead guide, the feed roller being supported so as to be slidable in its axial direction; drive means for rotating the lead feed roller about its axis; and operating means mounted on the outside of the casing for operating the drive means.

2. A mechanical pencil according to claim **1** in which the lead feed means includes two feed rollers with the helical rib on the one feed roller proceeding in the opposite direction from the helical rib on the other feed roller; and said drive means includes means for rotating the two feed rollers in opposite directions.

3. A mechanical pencil according to claim **1** in which said lead feed means comprises a first, a second and a third roller which are spaced apart approximately 120° about the axis of the central bore so as to surround the lead; and wherein said drive means includes means for simultaneously rotating the three feed rollers about their respective axes.

4. A mechanical pencil according to claim **3** in which the helical ribs on the first, the second and the third feed roller proceed in the same direction; and said drive means includes means for rotating all the feed rollers in the same direction.

5. A mechanical pencil according to claim **3** in which the helical rib on the first feed roller proceeds in the opposite direction from the helical ribs on the second and the third feed roller; and said drive means includes means for rotating the first feed roller in the opposite direction from the second and the third feed roller.

6. A mechanical pencil according to claim **1** in which the feed roller has a tapered portion at its end which is located nearer the lead-containing sleeve, the tapered portion having a diameter which gradually reduces toward the lead-containing sleeve.

7. A mechanical pencil according to claim **11** in which the rear end of the lead guide pipe is fitted into a portion of the lead-containing sleeve which has a reduced diameter, the lead guide pipe being formed with a notch in its peripheral surface in a region adjacent to the feed roller, the notch extending axially of the feed roller to enable the feed roller to engage with the lead in the region of the notch.

8. A mechanical pencil according to claim **1** in which said operating means comprises a cylindrical member which is mounted on the rear end of a casing so as to be rotatable about the axis of the central bore, the rear end of the lead-containing sleeve being firmly connected with the cylindrical member such that rotation of the cylindrical member is effective to rotate the lead-containing sleeve thereby operating the drive means.

9. A mechanical pencil according to claim **8** in which said drive means comprises annular rack teeth formed around the circumference of the lead-containing sleeve at its front end, and a drive gear mounted on the shaft of the feed roller and meshing with the rack teeth.

10. A mechanical pencil according to claim **1** in which said drive means comprises a power supply, an electric motor driven by the supply, and a reduction gearing located within the casing and transmitting the rotation of the motor to the lead feed means; said operating means comprising switch means for controlling rotation of the motor in the forward or reverse direction.

11. A mechanical pencil according to claim **10** in which the supply and the motor are received in a housing which is detachably fitted on the rear end of the casing.

12. A mechanical pencil according to claim **10** in which the supply and the motor are received in an external casing, and the drive shaft of the motor and the reduction gearing are connected together through a flexible shaft.

13. A mechanical pencil according to claim 1 in which said drive means comprises a power supply, an electric motor driven by the supply, and a reduction gear mechanism which transmits the rotation of the motor to the lead feed means; said operating means comprising switch means for controlling rotation of the motor in the forward or reverse direction, the motor being located within the casing between the lead feed means and the lead-containing sleeve, the motor having a hollow drive shaft through which a lead from the lead-containing sleeve is fed to the lead feed means.

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